Read Pauling 1954 Nobelist

CHEMISTRY

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The Nobelists of 1954

➤ AWARD of the Nobel Prize in Chemistry this year to Dr. Linus Pauling recognizes the genius of a man who is not afraid to upset outworn tradition. Elsewhere in this issue appears the list of achievements of this man of many interests. Just a year ago he was posing for the picture on the opposite page, explaining how the strands of protein structures twine together to make the rope-like molecules of collagen, skin, horn and hair.

In his classic work on the nature of the chemical bond, Pauling breaks with the tradition of the mechanical model of molecular structure. The bonding has proved to be due to interpenetration of the "electron clouds" which surround atomic nuclei. Some atoms are held by the specially strong bonding which Pauling calls "resonance."

In giving the awards in physics this year, the Nobel Prize committee is filling in the background of recognition to pioneers in atomic research. Bothe and Born were such pioneers, a quarter of a century ago. In the quotations reprinted in this issue they were then posing problems on which they and other physicists are still working.

Bothe created the coincidence counter when he put two shielded instruments in the path of the newly discovered cosmic rays. The question of whether particles of matter are created in outer space and come to earth as heavy nuclei along with the short-wave cosmic radiation is still being studied with instruments evolved from the ones physicists built then. Radiation from beryllium still interests physicists, besides its sinister significance in nuclear weapons.

Born, whose work centers around the spectral lines of the elements, bridges the gap between physics and chemistry. Students confused by the wealth of nuclear detail appearing in modern researches should read Born's work to learn the source in observable phenomena from which a great deal of modern theoretical speculation originates.

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Editors: WATSON DAVIS and HELEN MILES DAVIS

Consulting Editor: PAULINE BEERY MACK (Editor 1927-1944)

▸PROTEINS *are built like a rope. Dr. Linus Pauling illustrates how they twist.*

Pauling 1954 Nobelist

▸FORCES that hold all matter together, ranging from forces inside the atom to those that build protein molecules into flesh, hair and blood, are better understood because of the work of Dr. Linus Pauling, chairman of the division of chemistry and chemical engineering at the California Institute of Technology, who was awarded the Nobel Prize in Chemistry for 1954.

Structure of the atom as revealed by light emitted by heated materials was one of the fields first exp'ored by Dr. Pauling. This led him to discovery of laws of chemical combination, explained by him in his classic work, "The Nature of the Chemical Bond." Determination of spiral structures, like the strands of a twisted rope, which make up skin, hair, and many other structures of living tissue have won Dr. Pauling recent honors. His discovery that some types of anemia are due to defective blood hemoglobin structure opens a new method of attack on diseases like cancer whose causes are now obscure.

American Nobelist Interested In Many Chemical Structures

Scientific Work of Linus Pauling

▶ LINUS PAULING's most important contribution to science has been his discovery of fundamental principles determining the nature of the chemical bond and the structure of molecules. This has led him to important discoveries concerning the essential atomic structure of proteins, including such physiologically important materials as hemoglobin, blood serum, enzymes, hair, skin and muscle. Proteins are the major components of all living cells and are the principal building blocks of the body.

Dr. Pauling and his associates began working on the structure of proteins in the mid-thirties. The determination of certain molecular structures by x-ray diffraction had been pioneered at the California Institute of Technology as early as 1916. Proteins, however, are so complicated that their structure could not until recent years be revealed by this method. Unlike most other chemicals, which consist of only a score or two of individual atoms, protein molecules are made up of thousands, even millions, of atoms. Thus, instead of trying to study the protein molecules directly, Dr. Pauling went to work on the component parts of proteins, such as the amino acids. Analyzing these by x-ray diffraction, he ultimately obtained enough information to permit a precise prediction of the configuration of the oxygen-hydrogen-nitrogen-carbon chains that form the backbone of protein molecules.

During the past two years, Dr. Pauling has been working on the structure of collagen, the protein that occurs in tendons, bones and skin. It is probably the most important protein in the human body, for it gives strength and toughness to tissues. There is evidence now that many diseases, such as arthritis, seem to involve some abnormality in the manufacture or structure of this protein.

It is hoped that knowledge of the atomic structure of proteins will be a valuable tool in medical research. Dr. Pauling and his associates have already found that sickle-cell anemia is associated with an abnormality in the hemoglobin molecules of the patients.

For many years Dr. Pauling has also been interested in the structure of metals and alloys and the relation of structure to properties of these substances. Between 1938 and the present he has been working on the development of a theory of the electronic structure of metals and alloys that differs considerably from the quantum mechanical theory generally accepted. A principal difference is that Dr. Pauling assumes that a larger number of electrons are involved in bonding the atoms together than has previously been thought. Two years ago he applied his general ideas about metals in the statement of a new theory of the ferro-magnetism of iron and other magnetic substances. This theory explains in a straightforward way the existence of magnets.

Recently Dr. Pauling and two associates, Dr. Robert B. Corey and Dr. Richard E. Marsh, have completed a detailed investigation of the molecular structure of silk. Silk fibers are very strong — stronger than the strongest steel wires with the same cross-sectional area. The molecular structure found for silk by Dr. Pauling and his associates explains this strength in a simple way. The structure of silk involves extremely long molecules of silk protein, extending in the direction of the fibers. These molecules are attached to one another by hydrogen bonds, which connect each molecule with two others, one on each side. These molecules form what the investigators term "pleated sheets". The silk fiber consists of many of these sheets arranged side by side. The great strength of the fiber results from the fact that in order to break it, it is necessary to break the molecules themselves — that is, to break chemical bonds between atoms of carbon and nitrogen.

Dr. Pauling's experimental research includes the determination, by x-ray diffraction of the structure of about 50 crystals, and, by electron diffraction, of about 60 gas molecules. In the general field of molecular structure, his discoveries of fundamental principles include: the hybridization of bond orbitals and the theory of directed valence (1928); the relation of hybrid bond orbitals to magnetic properties of substances (1931); the partial ionic character of single bonds and relation to heats of formation of substances (1932); the resonance of molecules among two or more electronic structures and the determination of the configuration of molecules through resonance, such as the planarity of conjugated systems (1932); and the correlation of interatomic distances and other structural features with electronic structure (1932). In the elucidation of protein structure, Dr. Pauling's contributions include the discovery of the extraordinary magnetic properties of hemoglobin and their interpretation in terms of molecular structure (1936, with C. D. Coryell); the development of a general structural theory of native, denatured and coagulated proteins (1936, with A. E. Mirsky); the formulation of a theory of molecular structure of antibodies and the nature of serological reactions (1940); the discovery that an abnormality in molecular structure of hemoglobin is responsible for sickle-cell anemia (1949, with H. A. Itano, S. J. Singer, and I. C. Wells); and the discovery of the configuration of polypeptide chains in some fibrous and globular proteins (1950, with R. B. Corey).

Eigenfunctions

▸IN THE FOLLOWING quotation from Dr. Pauling's description of the bonds which hold chemical compounds together, the nomenclature of the newer physics refers to formulas which describe these energy phenomena in terms of wave equations.

These formulas are limited by the condition that only certain functions, called "characteristic functions" or "eigenfunctions," satisfy the requirements for a given system.

The Chemical Bond

The Nature of the Chemical Bond. Application of results obtained from the quantum mechanics and from a theory of paramagnetic susceptibility to the structure of molecules. By Linus Pauling. Journal of the American Chemical Society, Vol. 53, April, 1931, p. 1367-1400.

➤ WITH THE AID of the quantum mechanics there is formulated a set of rules regarding electron-pair bonds, dealing particularly with the strength of bonds in relation to the nature of the single-electron eigenfunctions involved.

It is shown that one single-electron eigenfunction on each of two atoms determines essentially the nature of the electron-pair bond formed between them; this effect is accentuated by the phenomenon of concentration of the bond eigenfunctions.

The type of bond formed by an atom is dependent on the ratio of bond energy to energy of penetration of the core (s-p separation), When this ratio is small, the bond eigenfunctions are p eigenfunctions, giving rise to bonds at right angles to one another; but when it is large, new eigenfunctions especially adapted to bond formation can be constructed. From s and p eigenfunctions the best bond eigenfunctions which can be made are four equivanent tetrahedral eigenfunctions, giving bonds directed toward the corners of a regular tetrahedron.

These account for the chemist's tetrahedral atom, and lead directly to free rotation about a single bond but not about a double bond and to other tetrahedral properties.

A single d eigenfunction with s and p gives rise to four strong bonds lying in a plane and directed toward the corners of a square. These are formed by bivalent nickel, palladium, and platinum. Two d eigenfunctions with s and p give six octahedral eigenfunctions, occurring in many complexes formed by transition-group elements.

It is then shown that (excepting the rare-earth ions) the magnetic moment of a non-linear molecule or complex ion is determined by the number of unpaired electrons, being equal to

$$\mu s = 2 \sqrt{S(S+1)},$$

in which S is half that number. This makes it possible to determine from magnetic data which eigenfunctions are involved in bond formation, and so to decide between electron-pair bonds and ionic or ion-dipole bonds for various complexes.

It is found that the transition-group elements almost without exception form electron-pair bonds with CN, ionic bonds with F, and ion-dipole bonds with H_2O; with other groups the bond type varies.

Examples of deductions regarding atomic arrangement, bond angles and other properties of molecules and complex ions from magnetic data, with the aid of calculations involving bond eigenfunctions, are given.

It takes one hour for 10 kilowatts of electricity to produce one pound of primary aluminum.

Two Atomic Pioneers Win Nobel Physics Prize

Born and Bothe Honored

▸ TWO PIONEERS in the conversion of solid matter into invisible energy and vice versa have been jointly awarded the 1954 Nobel Prize in physics.

They are German-born Max Born, 72, a naturalized British citizen now living in Heidelberg, West Germany, and Walter Bothe, 63, of Heidelberg University.

In 1931, Dr. Bothe and Dr. H. Becker tapped the energy of the atomic nucleus. They bombarded a beryllium target with alpha particles, causing the beryllium to emit X-rays of considerably more power than the bombarding particles.

Commenting on these experiments, Prof. Arthur H. Compton foresaw the possibility of getting useful energy from the atom, now a reality.

Prof. Born was one of the first physicists to attempt to reconcile classical physics with the quantum mechanics, in order to explain the structure of the atom, work basic to today's atomic piles and hydrogen bombs.

Prof. Born was cited for his fundamental research in quantum mechanics, particularly his statistical interpretation of the wave function.

Prof. Bothe was honored for the discoveries resulting from his method of coincidence counting. By this technique, two Geiger-Muller tubes are connected in series, and only those atomic reactions making both tubes conducting simultaneously are recorded.

Coincidence counting was used by Prof. Bothe and the late Dr. Hans Geiger to establish that cosmic rays observe the principle of energy conservation. Some physicists in 1925 thought that energy was not conserved in the individual scattering process, but only as the average for many such processes.

Experiments Explained

by PROF. W. BOTHE

▸ OUR EXPERIMENTS show that energy is gained if any alpha particle is shot into the beryllium nucleus. That is to say, by addition of an alpha particle to the beryllium nucleus, a carbon nucleus of atomic weight 13 is produced which contains less energy than the two original nuclei together.

These experiments give a hint as to the way in which the building up of the atom nuclei actually takes place in the universe: The heavier nuclei are produced by steps from the lighter.

The hypothesis which Dr. Robert A. Millikan has made to explain the "ultra-rays" (cosmic rays), that the heavy nuclei are formed direct by the sudden combination of a great number of protons and electrons, is accordingly very improbable.

In still another connection the gamma radiation from beryllium is of interest in connection with the problem of the cosmic rays. The new rays are

much harder than the known radioactive gamma rays, their penetrating power approaches close to that of the softest components of the cosmic rays.

Thus in the beryllium rays one can study the properties of a gamma radiation which has approximately the penetrating power of the cosmic rays. As is well known, my earlier experiments with Prof. Werner Kolhorster* showed that the properties of the cosmic rays are very different from those of a gamma radiation, and that the cosmic rays behave rather as a corpuscular radiation.

Dr. H. Becker and I have now carried out the same experiments with the gamma rays from beryllium; it turns out that these still behave completely like a normal gamma radiation and quite differently from the cosmic rays.

This is further strong support for the idea that the cosmic rays have a particle-like nature in the lower layers of the atmosphere.

A series of other light elements, as well as beryllium, can be artificially excited to gamma ray emission. The production of artificial gamma rays is just as general a phenomenon as the breaking up of atomic nuclei.

In this radiation we have a means of studying the structure of the lighter atomic nuclei; we are standing at the threshold of a "nuclear spectroscopy."

Indeed the light atom nuclei are of special interest.

(Reprinted from Science News Letter, March 12, 1932, p. 159.)

*Account of Earlier Experiments

➤ THE two German physicists obtained their results with a specially built adaptation of the physical instrument known as the electron counter. It consisted of a cylindrical chamber, within which was a very slender oxidized wire, connected to an electroscope. Whenever a charged particle made contact with the wire the electroscope registered the impact.

Using two of these instruments one above the other within a lead-armored vessel to keep out the earth-originated radiations, Dr. Bothe and Dr. Kolhörster frequently obtained coincidental registrations of particle impacts on their electroscopes. These they regard as having been due, in most cases, to the same particle striking both wires in succession. This would indicate that the particle came from above, with sufficient velocity to carry it through the lead armor and both tubes.

(Reprinted from Science News Letter, Feb. 1, 1930, p. 76.)

Computer Probes Protein Structure

➤ THE MANIAC, an electronic computer at Los Alamos Scientific Laboratory, is being used to learn more about protein structure, two scientists revealed to the National Academy of Sciences.

The computer "builds" artificial protein molecules at random from any of the 20 different amino acid building blocks, according to a specified code. The proteins resulting from the machine's computations are compared with those found in nature, Prof. George Gamow of George Washington University, Washington, D.C., and Dr. N. Metropolis of Los Alamos Scientific Laboratory report.

Reconciliation of Old and New Theories in Modern Physics

Waves and also Corpuscles

Quotation from ATOMIC PHYSICS *by Max Born. Authorized Translation from the German Edition by John Dougall. G. E. Stechert & Co., New York, 1936.*

▸ WE HAVE HAD a series of facts brought before us which seem to indicate unequivocally that not only light, but also electrons and matter, behave in some cases like a wave process, in other cases like pure corpuscles. How are these contradictory aspects to be reconciled?

To begin with, Schrödinger attempted to interpret corpuscles, and particularly electrons, as *wave packets*. Although his formulae are entirely correct, his interpretation cannot be maintained, since on the one hand, as we have already explained above, the wave packets must in course of time become dissipated, and on the other hand the description of the interaction of two electrons as a collision of two wave packets in ordinary three-dimensional space lands us in grave difficulties.

The interpretation generally accepted at present goes back to the present writer. According to this view, the whole course of events is determined by the laws of probability; to a state in space there corresponds a definite probability, which is given by the de Broglie wave associated with the state.

A mechanical process is therefore accompanied by a wave process, the guiding wave, described by Schrödinger's equation, the significance of which is that it gives the probability of a definite course of the mechanical process. If, for example, the amplitude of the guiding wave is zero at a certain point in space, this means that the probability of finding the electron at this point is vanishingly small.

The physical justification for this hypothesis is derived from the consideration of scattering processes from the two points of view, the corpuscular and the undulatory. The problem of the scattering of light by small particles of dust or by molecules, from the standpoint of the classical wave theory, was worked out long ago.

If the idea of light quanta is to be applied, we see at once that the number of incident light quanta must be put proportional to the intensity of the light at the place concerned, as calculated by the wave theory. This suggests that we should attempt (Born, 1926) to calculate the scattering of electrons by atoms, by means of wave mechanics.

We think of an incident beam of electrons as having a de Broglie wave associated with it. When it passes over the atom this wave generates a secondary spherical wave; and analogy with optics suggests that a certain quadratic expression formed from the wave amplitude should be interpreted as the current strength, or as the number of scattered electrons.

On carrying out the calculation (Wentzel, Gordon) it has been found that for scattering by a nucleus we get

exactly Rutherford's formula. Many other scattering processes were afterwards subjected to calculation in this way, and the results found in good agreement with observation (Born, Bethe, Mott).

These are the grounds for the conviction of the correctness of the principle of associating wave amplitude with number of particles (or probability).

In this picture the particles are regarded as independent of one another. If we take their mutual action into account, the pictorial view is to some extent lost again. We have then two possibilities. Either we use waves in spaces of more than three dimensions (with two interacting particles we would have $2 \times 3 = 6$ co-ordinates), or we remain in three-dimensional space, but give up the simple picture of the wave amplitude as an ordinary physical magnitude, and replace it by a purely abstract mathematical concept (the second quantisation of Dirac, Jordan) into which we cannot enter.

Neither can we discuss the extensive formalism of the quantum theory which has arisen from this theory of scattering processes, and has been developed so far that every problem with physical meaning can in principle be solved by the theory.

What then is a problem with physical meaning? This is for us the really important question, for clearly enough the corpuscular and wave ideas cannot be fitted together in a homogeneous theoretical formalism, without giving up some fundamental principles of classical theory.

The unifying concept is that of probability; this is here much more closely interwoven with physical principles than in the older physics.

The elucidation of these relationships we owe to Heisenberg and Bohr (1927). According to them we must ask ourselves what after all it means when we speak of the description of a process in terms of corpuscles or in terms of waves.

Hitherto we have always spoken of waves and corpuscles as given facts, without giving any consideration at all to the question whether we are justified in assuming that such things actually exist.

The position has some similarity to that which existed at the time the theory of relativity was brought forward. Before Einstein, no one ever hesitated to speak of the *simultaneous* occurrence of two events, or ever stopped to consider whether the assertion of the simultaneity of two events at different places can be established physically, or whether the concept of simultaneity has any meaning at all.

In point of fact Einstein proved that this concept must be "relativized," since two events may be simultaneous in one system of reference, but take place at different times in another.

In a similar way, according to Heisenberg, the concepts corpuscle and wave must also be subjected to close scrutiny. With the concept of corpuscle, the idea is necessarily bound up that the thing in question possesses a perfectly definite momentum, and that it is at a definite place at the time considered.

But the question arises: can we actually determine exactly both the position and the velocity of the "particle" at a given moment?

If we cannot do so—and as a matter of fact we cannot—i.e. if we can never actually determine more than one of the two properties (possession of a definite position and of a definite momentum), and if when one is determined we can make no assertion at all about the other property for the same moment, so far as our experiment goes, then we are not justified in concluding that the "thing" under examination can actually be described as a particle in the actual sense of the term.

We are equally unjustified in drawing this conclusion even if we can determine both properties simultaneously, if neither can then be determined exactly, that is to say, if from our experiment we can only infer that this "thing" is somewhere within a certain definite volume and is moving in some way with a velocity which lies within a certain definite interval.

We shall show later by means of examples that the simultaneous determination of position and velocity is actually impossible, being inconsistent with quantum laws securely founded on experiment. . . .

New Optical Device, Axicon, Needs No Focusing

▶ A NEW KIND of optics, which makes possible an unusual sort of lens without definite focal length, made its bow in a communication to the Optical Society of America. Dr. John H. McLeod of Eastman Kodak Co. is the physicist who made this development.

Axicon is the term applied to the new class of optical elements. Axicon means axis image. Axicons form a continuous straight line of images from small sources.

The most important axicon is a glass cone. This can be used in a telescope. The usual spherical objective is replaced by the cone. This axicon telescope is in focus for targets from a foot or so to infinity without the necessity of moving any parts. It can be used to view simultaneously two or more small sources placed along the line of sight.

Add a source of light and this kind of telescope becomes an autocollimator, which can be used to determine whether a mirror is perpendicular.

A search for a universal-focus lens led to this new class of optical elements.

Interference for Microscope Smoothness

▶ FOR MEASURING smoother surfaces, General Motors Research Laboratories is using an interference microscope, which detects depressions and ridges of two to 100 millionths of an inch.

One of three such instruments built in the United States, it determines extremely small depths by comparison with a beam of light from a flat reflecting surface.

The microscope is being applied to plating thickness, effects of weathering on painted surfaces, standardization of machine part surfaces, corrosion pitting and other such uses.

Medical Nobelists Paved Way For Polio Vaccine

Medical Prize for Tissue Culture

➤ MILLIONS of children and their parents in America and throughout the world will feel a close personal link to the 1954 Nobel Prize Award in Medicine. Because this award goes to the men who primarily may be responsible for a vaccine to protect against the disease that makes crutch, brace, wheel-chair and iron lung cripples of many of its victims.

The men are Drs. John F. Enders and Thomas H. Weller of the Children's Medical Center, Boston, and Dr. Frederick C. Robbins of Western Reserve University School of Medicine and City Hospital, Cleveland.

These men were the first to grow the polio viruses outside the body in what the layman would call test tubes. Actually, the so-called test tubes are flasks in which body cells grow and live. These are tissue cultures, and the feat of growing polio viruses in tissue cultures has been called the "shining new tool of poliomyelitis diagnosis and research" by Dr. Hart Van Riper of the National Foundation for Infantile Paralysis.

These cultures, as used for viruses for the Salk vaccine now under trial, are cultures of monkey kidney and testicular cells.

Previously, scientists had believed that polio viruses could live and thrive only on cells of the nervous system in the brain and spinal cord. Discovery by the Enders team that these viruses would live and grow in non-nervous tissue removed one of the big road blocks to development of a vaccine and also to a relatively inexpensive method of isolating and identifying the polio virus and thus of diagnosing the disease in doubtful cases.

Heretofore this could only be done by inoculating material suspected of containing the virus into live monkeys and waiting until the animals did or did not develop polio.

With the standard tests used before the Enders-Wellers-Robbins achievement, it took more than 30,000 monkeys and over one million dollars just to classify the three polio viruses.

Safer Muscle Relaxing Compounds

➤ DOCTORS may soon have new and safer drugs for relieving bronchial spasms, biliary colic and spasms of stomach and intestinal tract.

The new compounds are analogues of opium's anti-spasm drug, papaverine. In laboratory tests they showed promise of relieving intestinal spasm. When injected into the veins of mice, they proved two to three times safer than papaverine in toxic quality.

The compounds were synthesized and studied by Drs. J. Cymerman-Craig, K. V. Martin, P. C. Wailes, R. H. Thorp, R. Ladd and G. Thorburn of the University of Sydney, Australia.

Man in America
For 24,000 Years

Radiocarbon Dates Man in America

MAN has lived in America twice as long as scientists have supposed.

Radiocarbon dating of fragments of charcoal found buried beneath an ash bed at Tule Springs, Nevada, and believed to be of "human origin" has pushed back the dawn of human life on American soil to more than 23,800 years ago. This date is included in a new compilation of radiocarbon dates issued by Prof. Willard F. Libby of the University of Chicago, now on leave to serve as a member of the Atomic Energy Commission.

Folsom Man who hunted now extinct mammoths in America's Southwest, and long believed to be the first American, has been dated by the radiocarbon method at about 10,000 years ago. Tepexpan Man, Mexico's first resident and contemporary of Folsom Man, has been dated at between 10,000 and 12,000 years ago.

But now it seems that man was living and perhaps cooking over a campfire in Nevada as much as 12,000 years before Folsom Man and Tepexpan Man were hunting their ancient elephant game.

The carbon sample was collected by Drs. Fenley Hunter and M. R. Harrington of Southwest Museum, Los Angeles.

Actually, the Nevada resident may have been much older. The antiquity of 23,800 years given by Dr. Libby for the Tule Springs sample is close to the limit of his radiocarbon dating method, so that he can only give the date as "older than 23,800." No one can now say how much older it may be.

Fresh confirmation of the Spinden correlation for relating dates in the ancient Mayan calendar of Guatemala to our own calendar is included in Dr. Libby's compilation. For a long time scientists disagreed about how to interpret Mayan dates according to our calendar. One ancient door frame in Guatemala has a Mayan date carved into it. According to the method developed by Dr. Herbert J. Spinden, the date by our calendar would be Oct. 30, 481 A.D. According to the other method worked out by Drs. J. T. Goodman and J. Eric Thompson, the date would be June 30, 741 A.D.

In November, 1951, Dr. J. L. Kulp of the Lamont Geological Laboratory found by radiocarbon dating that the correct date was 481 A.D., thus confirming the Spinden correlation. Now Prof. Libby has found a radiocarbon date for another door frame from Guatemala bearing the same Mayan date. His result is a little different from that of Dr. Kulp, but even older. He obtained a date of 451 A.D., with a possible error of 110 years plus or minus, furnishing fresh confirmation of the Spinden correlation.

Great antiquity was confirmed for a skull found in Florisbad, Orange Free State, South Africa, by another dating in the compilation. This was the dating of peat in which the skull was

found. The sample was sent in by Dr. A. C. Hoffman, director of the National Museum, Bloemfontein, South Africa.

This skull has been judged by anthropologists by other evidence to be very ancient. The structure of the skull indicates that it is transitional between Neanderthal and Modern Man. It has been placed at middle Pleistocene or roughly from 100,000 to 300,000 years ago.

Prof. Libby's radiocarbon dating confirms that it is very old, but again limits of the scale make it impossible to say exactly how old, so the verdict is "older than 41,000 years."

New Carbon 14 Method

➤ Possessions of ancient man, wisps of fur or shreds of hide from man's forerunners on earth, can be dated more accurately by a new method of getting carbon 14 into gaseous form for the analysis.

Earlier methods deposited the radiocarbon separated from the antique sample as a smudge of soot in which the carbon was in solid form. The new technique, just being tried out, converts the tell-tale carbon isotope into acetylene gas.

This gas can be led through measuring devices and Geiger counters to give more accurate readings when plenty of material can be used, or good readings from rarer and smaller samples. The apparatus was demonstrated to visiting geologists in New York City at the Crust of the Earth Symposium, part of Columbia University's two hundredth anniversary celebration.

Carbon 14 age determination is only one of the methods by which ages of ancient materials, both remains of once-living creatures and aggregations of rocks and minerals, can be dated. At Columbia's Lamont Geological Observatory the ages of rocks are determined by the proportion of an original element to that of its associated daughter-element produced by radioactive decay. Potassium and argon are such a pair of elements studied by Dr. J. Laurence Kulp and his team of graduate students.

Argon, a heavy gas which forms no chemical compounds, is found trapped in the potassium minerals from which it has been produced by radioactive transmutation. Dr. Kulp's group has worked out a method of collecting this gas as it is set free, measuring it, and from its rate of formation calculating the time necessary for its formation.

Work with other radioactive elements carried on at the new laboratory includes determination of tritium, strontium, uranium, lithium and lead. Origin of sulfur in salt dome oil fields is also sought by new methods of mineral study.

On the Back Cover

➤ The cave *in which the radiation source will be contained in the new radiation laboratory is being built by Standard Oil Development Co. at Linden, N.J. Radiocobalt will be contained in pipe A. Remote control apparatus for handling irradiated material is at B. A three-foot-thick window of lead glass is at C. D shows the cutaway representation of the concrete walls which are more than four feet thick.*

Mixing Fresh and Sea Water Gives Electricity Source

Novel Sources of Power

➤ ELECTRICITY has been produced in small amounts by mixing fresh water and sea water. Demonstrated by R. E. Pattle at the British Department of Scientific and Industrial Research's Chemical Research Laboratory, it is declared the first mention of "an untapped source of power."

The osmotic pressure of sea water is about 20 atmospheres, it is explained. When a river mixes with the sea, free energy equal to that obtainable from a waterfall 680 feet high is lost.

The British experiment put the osmotic pressure to work by separating alternate layers of salt and fresh water by alternate basic and acidic membranes. The membranes are connected in series and yield electricity.

A hydroelectric pile of 47 pairs of membranes each three inches square yielded a maximum of 15 milliwatts, not counting the internal resistance overcome.

At low temperatures, the report to the British journal, *Nature*, states, the internal resistance is higher and the power output is lower. The pile is therefore likely to be more economical in a warm and equable climate. Whether the process will work economically probably depends upon the time it will run before the membranes need replacing and the interior needs cleaning. The membranes incorporate ion exchange resins. When such a membrane separates two salt solutions of different strengths, a potential difference appears across it.

Atomic "Heat Battery"

➤ AN ATOMIC battery with a blistering hot core of radioactive polonium has been developed in the Atomic Energy Commission's Mound Laboratory at Miamisburg, Ohio.

Developed by John H. Birden and Kenneth C. Jordan, laboratory scientists, the battery applies the heat of its capsuled core to 40 thermocouples. The thermocouples, each of which is a pair of two dissimilar metals joined at one end, convert the heat into tiny amounts of electric energy.

The battery is small and light and its voltage-current rating can be varied by proper choice of wire size and the number of thermocouples used. The Mound battery uses a polonium heater of 4.65 watts and delivers a maximum electrical power of .0094 watts. When not loaded, the battery's voltage measures .75 volts and its maximum current can reach .025 amperes.

Believed to be useful in instruments where long-life dependability is required, the battery's polonium heart emits alpha particles and reaches temperatures of 450 degrees F. The outside of the battery is shielded from this heat so that no fingers are burned when the battery is handled. Polonium's radioactive half-life is 138 days.

The Mound Laboratory is operated for the Atomic Energy Commission by the Monsanto Chemical Company.

Powered by Sun's Rays

➤ THE SUN'S rays provide the power for a new experimental radio transmitter the size of a package of cigarettes.

The device, developed by Edward Keojian in General Electric's Electronics Laboratory, uses transistors instead of tubes and has a range of 100 feet. The transmitter is self-contained. When light hits the special selenium solar energy converters, enough current is generated to operate the device.

The range could be increased either by adding more selenium converters or by using silicon or germanium instead of selenium.

Energy Directly From Soil

➤ "HYDROGENOMONAS," tiny bacteria that obtain energy directly from their inorganic environment, are being studied at the University of California at Los Angeles.

Dr. Daniel E. Atkinson of U.C.L.A.'s department of chemistry is making the study of these bacteria which live in the soil.

He is interested in the organisms because they utilize possibly the simplest process of obtaining energy from inorganic matter.

Most animals obtain energy in a sort of prefabricated form, that is, from carbohydrates and fats produced by living things, he explained. "But the Hydrogenomonas, like green plants, obtain energy from the inorganic environment and make their own carbohydrates.

Unlike plants, however, the tiny soil bacteria, in their dark domain, cannot utilize light energy as plants do in photosynthesis. Instead they obtain energy from a reaction between hydrogen and oxygen.

Hydrogen and carbon dioxide released by other organisms that live deeper in the soil percolate up to them. Oxygen is obtained through the topsoil from the atmosphere.

A complex chemical action of the three gases, aided by enzymes, results in carbohydrates, which are then utilized in living processes as in other organisms.

Granite Dust is Fertilizer

➤ GRANITE ROCK ground very finely and spread on the fields is good fertilizer, supplying potassium, to alfalfa and clovers.

This was reported to the New Hampshire State Planning and Development Commission by Prof. Charles J. Lyon, chairman of Dartmouth College's botany department, as the result of experiments.

Two granite minerals, feldspar and mica, supply potassium, one of the three main fertilizer elements, that can be used by some plants. Some plants, including tomatoes, sweet corn and tobacco, are not benefited at all.

New Hampshire is known as the Granite State. Experiments aimed at discovering why some plants, like the legumes, are able to use the potassium from the granite dust and some others do not are being continued.

Delivered Through a Hose, Cross-linked into Place

House of Plastic Foam

▸ THE WALLS of your house in the "blue-sky future" may be foamed into place rather than hammered and nailed, or laid by high-priced brick masons. But that day is a long way off.

This was one of several futuristic ideas presented to a conference on Plastics in Building sponsored by The Society of the Plastics Industry, the Manufacturing Chemists' Association, and the Building Research Advisory Board of the National Academy of Sciences.

Other experts described houses that bloom like daisy buds to invite the freshness of springtime into your living room, houses built into hillsides for atomic reasons, and floating civilizations girdling the earth's equator in a 1,000 mile-wide belt.

Raymond F. Boyer, director of the physical research laboratory of The Dow Chemical Company of Midland, Mich., said he believes it may be possible to build houses with a plastic foam.

He pictured a device resembling a garbage can which would be the plastic "concrete mixer." It would generate foam and force it through a hose to a workman.

Using only rudimentary forms to contain the plastic until it set, the workman would build up the wall quickly. The experts would focus the radiation of a high-voltage X-ray machine or radioactive cobalt 60 on the wall to raise its structural strength by cross-linking the plastic molecules.

Mr. Boyer said he does not know just how all this is to be done in reality, but that the idea might be worth playing with.

James W. Fitzgibbon, executive vice-president of Geodesics, Inc., of Raleigh, N.C., showed how geometric forms can be linked in such a way that a twist to the "roof" makes the flexible house unfold like a daisy bud.

One of his theoretical designs resembled a pyramid with a pole sticking out the top. When the pole was shoved down, the three walls of the pyramid flipped outward.

Dr. Johan A. Bjorksten, president of Bjorksten Research Laboratories of Madison, Wis., described a house his company is building. When finished, it will be 95% underground.

The cost of this house, designed for a hillside, is estimated to be less than for its equivalent above ground. Maintenance and heating costs should be far less, he said. And it will have excellent resistance to atomic shock waves.

Properly used plastic films will keep the house from becoming dank. Large picture windows jutting through the hillside will admit light to the structure.

Looking into the "blue-sky future," Dr. Bjorksten said rapid population increases may be threatened by a limited world food supply. Since man cannot make more farm land, humanity is faced with three choices:

Rigid birth control in all countries.

An atomic war "sufficiently intended" to wipe out at least half of the earth's population.

Cultivation of the oceans.

Amplifying the last point, he said a band 500 miles on each side of the equator is almost perpetually calm and the sun shines almost every day. The temperature is "pretty steady" at 86 degrees the year around.

"Development of extreme high-strength plastic films gives us a means by which it would be possible to utilize this immense belt for agricultural purposes," he said.

He described floating plastic stills, created under Department of Interior sponsorship, that convert salt water to fresh.

Fresh water from these stills could be used to cultivate plants floating in canoe-like plastic boats. He cited a man who already has such a garden plot floating in a lake.

➤ "YOU UNDERSTAND, *it's not perfected yet!*"

Pasadena Is Death Trap, Smog Scientist Says

Smog Studies Help Cities

▸PASADENA is a death trap. Any day now a smog may arise that could kill thousands of Californians and leave others with life-long scars.

But city officials can take firm steps today to avoid this catastrophe.

This is the opinion of Dr. Francois N. Frenkiel, physicist in the research center at Johns Hopkins University Applied Physics Laboratory, Silver Spring, Md.

Experts should pinpoint the sources of smog and determine which of these sources are the worst.

This is the first thing that must be done in any city, whether Pasadena or Pittsburgh.

Then, using high-speed electronic computers, they should set up a program for predicting in advance when a deadly smog condition is developing. A few hours' warning would give local officials time in which to take decisive steps to ward off danger.

This is the second thing that must be done. Otherwise thousands may die in Pasadena if weather conditions press a heavy smog over the city's face for several days.

The current danger in Pasadena is enormous, Dr. Frenkiel said. But residents have three immediate courses of action to follow should a death-dealing smog settle over the city:

They can shut down industry and their home furnaces, and stop driving their cars, trucks and buses.

Or they can run for the hills where the air is clean.

Or they can search out air conditioned buildings and spend long hours in them.

Otherwise many older persons may die, particularly those now afflicted with heart disease and bronchitis.

Many that escape death may be afflicted for life with diseases they now do not have. Some might contract bronchitis, and other might develop a heart condition. Some persons believe smog helps to spawn lung cancer.

Dr. Frenkiel's suggestions grew out of his work of harnessing high-speed computing machines to the smog problem. He was drawn into Pasadena's smog problem last May when he discussed the subject at a National Science Foundation symposium at the University of California at Los Angeles. Later he was called in as a consultant by the Southern California Air Pollution Foundation.

Computers could discover a dangerous smog condition in the making, he said. This would permit officials to shut down certain industries temporarily to avert a local disaster.

Dr. Frenkiel believes this is a realistic approach to a problem that is enveloping more and more American cities.

"We must learn to live with industry," he added. "After all, millions derive their livelihoods from our factories and chemical plants, and the

economic and military security of our nation depends upon our industrial output."

Attempting to change the Los Angeles climate, as some have suggested, is completely impractical, Dr. Frenkiel said. If temperature inversions (which prevent smog from escaping into the upper atmosphere) could be eliminated in Los Angeles, the area would become a desert, he said.

Even man's mightiest weapon, the hydrogen bomb, is puny in comparison to the capsuled energy needed to break up a temperature inversion. The bomb would destroy it only for a few hours at the most. This assumes, of course, that the H-bomb could be used on the atmospheric conditions without harming the city.

But high-speed computers would permit scientists to figure which spots are most critically endangered by smog. They would help experts determine whether it is best to invest in costly filters for industrial smoke stacks or to run the plants on a stop-when-necessary basis.

The computers also would permit forward-looking predictions to be made when a new industry declares its intention of building a new plant in the area. The machines could reveal whether the new plant will make the smog situation more dangerous. If so, city officials could specify areas of the city where the plant could be operated without hazard to local residents.

The machines also could produce useful data to show what would happen if the town begins growing in a different direction.

A Pasadena smog may now act on its victims exactly as the 1952 London fog affected Britishers, Dr. Frenkiel emphasized. Pasadena's smog contains elements that the London fog did not have.

But at its peak, London's soot-ladened fog killed 600 Britishers a day.

Deaths from bronchitis were nine times greater than the London average during the preceding 10-year period. The death rate from all causes was more than two and a half times greater than the average for the same 10-year period. All told, the fog is blamed for the deaths of 3,000 persons.

Paper Method Detects Smog

➤ A RELATIVELY simple way of detecting smog even when the air seems to be clear has been discovered by Drs. Bernard D. Tebbens and Jack D. Torrey of the University of California School of Public Health in Berkeley.

The method is paper chromatography, used in many laboratories to determine very small amounts of chemicals. Development of a colored spot on special paper when suitably treated material is placed on the paper tells the chemist what chemical is in the material. The California scientists filtered samples of San Francisco Bay Area air and put the solid particles collected by the filter on the paper.

Salts of acetic and formic acids were discovered by this method in the San Francisco air. These gases were also found in the exhaust gas of a relatively new automobile, an incinerator, a gas fire, and wood fire. Raw natural gas, on the other hand, did not contain any filterable acetate or formate.

Smog, the scientists point out, may be present even when there is no fog-

giness to reduce visibility. The reduced visibility may be simply the result of water condensed on normally present nuclei.

A fluorescent, oily material was also discovered in the San Francisco air during several characteristic air pollution episodes. This fluorescent oil and acetic and formic acids have also been found by Dr. Torrey in a sample of filtered air from Denver.

Carbon Filter For Vapors

▶ A NEW APPLICATION of the gas mask principle has been made to filter out odors and recover valuable vapors from hot industrial exhausts.

The process, now available commercially, uses activated carbon, known for centuries for its almost instantaneous purifying action. Two major obstacles to carbon as an industrial filter were overcome.

Since the substance will not act efficiently on hot, damp exhausts, the new device mixes cooler air with the fumes before they enter the filter. And the problem of regenerating the carbon was solved by periodical heating of the filter.

The gases collected by the second process can be condensed and separated for re use. In some plants millions of dollars worth of costly chemical solvents escape up the chimney which could be reclaimed by the new filter.

The Siftaire, manufactured by the Chemurgic Process Corp., is based on patents of Dr. Frank L. Schneider, microchemist and professor of chemistry at Queens College, New York.

Activated carbon is a black, spongelike substance. It contains many tiny holes and capillaries and can attract and hold contaminating vapors. One cubic inch of this special carbon contains an area, adding up the surfaces of all its pores, of about five acres, which is the basis of its absorbing properties.

Activated carbon is used in gas mask filters to protect soldiers and citizens from poison gas attacks.

The new filter may be of value to such industries as antibiotics, chemicals, cork, sewage, meat packing, paints, rubber, detergents and petroleum.

Dip Keeps Peeled Spuds Snowy White

▶ THOSE UNAPPETIZING, brownish gray potatoes sometimes seen in restaurants and institutions can be avoided in future. The remedy is an inexpensive sodium bisulphite dip, Prof. Karla Longree of Cornell University, has discovered.

Home cooks keep their potatoes snowy white by putting the peeled spuds quickly into water. But this method does not work for the machine-peeled potatoes.

A 30-second dip in a mixture of two tablespoons of sodium bisulphite to a gallon of water keeps the mechanically peeled potatoes from discoloration, Miss Longree found. After dipping, the potatoes are drained, covered with a cloth wrung out in the solution, and covered tightly until time for cooking. If they have to be held overnight, they are refrigerated.

Mold Remedies Tried In War on Cancer

Chemical Attacks on Cancer

➤ ANTIBIOTICS are entering the war against cancer. These chemicals belong to the group of mold remedies, so called because the first one, penicillin, comes from mold. Heretofore they have been famous for the number of germ diseases and infections which they can stop.

The new phase of the antibiotic era was discussed at the second annual symposium on antibiotics held under the auspices of the U.S. Food and Drug Administration and the Journal, *Antibiotics and Chemotherapy*.

Puromycin, one of the newer antibiotics, slows the growth of one kind of breast cancer transplanted into mice, a team of scientists from Lederle Laboratories, American Cyanamid Company, Pearl River, N.Y. reported.

One part of the molecule, the aminonucleoside portion, has the cancer-arresting activity, Drs. P. L. Bennett, S. L. Haliday, J. J. Oleson and J. H. Williams of Lederle have found.

Following this lead, they have tested a number of similar amino acid compounds and have found five that have equal or better anti-cancer activity in laboratory animals.

Puromycin comes from one of the Streptomyces soil organisms of the same general family that earlier yielded streptomycin.

Trial in human cancer patients of another antibiotic was reported at the meeting. This is a new antibiotic, actinomycin C. Its anti-cancer activity in mice and results of trial in 15 human patients were reported by Drs. John B. Field and Miss Francoise Costa and Miss Angela Boryzka of Schenley Laboratories Inc., New York.

New antibiotics reported at the sessions include: fungichromin and fungichromatin from Sharpe and Dohme, division of Merck and Co., Inc., West Point, Pa.; spiramycine from the Rhone-Poulenc Laboratories, Paris, France; etamycin from Bristol Laboratories, Inc., Syracuse, N.Y.; griseoviridin and viridogrisein from Parke, Davis and Company, Detroit; pleomycin from Sharpe and Dohme; anisomycin and PA-105 from Chas. Pfizer and Co., Inc., Brooklyn, N.Y., and celesticetin from the Upjohn Company, Kalamazoo, Mich.

Amebic infection, known to the layman as amebic dysentery, and the widespread infection of the female genital tract, trichomoniasis, are being effectively attacked by some of these antibiotics.

Plant Growth Stopper

➤ A CHEMICAL that makes plants stop growing without killing or harming them is being studied to see whether it has any possible cancer-checking effects. The study by Dr. Aubrey W. Naylor is supported by the American Cancer Society.

Maleic hydrazide is the chemical. It has been tested only in one or two cancer patients so far as is known. In these experiments, conducted by

others in San Francisco, it did not interfere with growth of the tumors.

Further studies are being undertaken however, in hope that the mechanism of action, if and when known, may suggest ways of arresting animal and human cancers.

Maleic hydrazide affects only the terminal growing parts of plants, that is, the tips of roots and stems and the buds. It does this by preventing the division of the very cells on which the plant depends for increased stature. The nuclei of these cells of treated plants swell and the cytoplasm which surrounds them becomes more transparent. This is a characteristic of cell injury without repair.

The older and well-formed leaves of plants treated with maleic hydrazide continue to live, but the growth of new, half-formed leaves ceases completely. The chemistry of the plant, its metabolism, slows down almost to a standstill.

Bigger Radioactive Blast

▶ A WAY to deliver a bigger radioactive blast at cancer of the pancreas has been developed by Dr. Paul Harper of the University of Chicago.

Treatment of cancer at this site has heretofore been unsatisfactory, Dr. Harper points out.

His method is to thread a fine, polyethylene tubing around and through the cancer. This is done during a surgical operation in which the abdomen is opened. The ends of the tubing are allowed to project outside the body after the surgical wound has been closed. Then radioactive iodine in liquid form is inserted in the tubing and the two ends are filled with either air or mercury and sealed.

The radioactive iodine can be left in the patient until it loses its radioactivity, which is a period of about eight days. Or it can be withdrawn if further surgery is needed. After the treatment is completed, the tubing can be left in the patient's body since it causes no difficulty.

Four of six patients treated so far have died, but in three of these it was found that the radiation had markedly decreased the size of the cancer. The remaining two patients, treated only recently, are still alive.

With the new treatment as much as eight or nine thousand roentgens of radiation can be delivered directly to the tumor. This dose is far above the tolerance level for treatment by external irradiation.

Dr. Harper reported his new method to the American College of Surgeons.

Surgical Resurfacing

▶ A RESURFACING operation to check the development of cancer was reported by Drs. John W. Draper and Richard B. Stark of New York Hospital and Cornell University Medical Center, New York, at the Atlantic City meeting of the American College of Surgeons.

The operation would be for patients who had over the years had multiple benign tumors of the bladder. With each recurrence, the doctors pointed out, these tumors become more malignant, until finally they become true malignant cancers.

In the hope of interrupting this usual progression from harmless to malignant tumors, the New York doctors decided to try resurfacing the lining of the bladder with skin. Tried

so far in dogs, this resurfacing operation seems to work. Although there is some loss of elasticity and consequent decreased capacity, no stones formed in the resurfaced bladders and there was no other sign of damage from the operation.

Evidence that the resurfacing operation would check the cancerous progression came when the doctors gave the four dogs with resurfaced bladders a drug called betanaphthelamine. This chemical is known to produce cancer in the bladder. The dogs got the chemical for 24 months, but so far there has been no sign of cancer developing.

For poor, miserable people at the end of the line because of cancer of the bladder or cancer of the prostate gland, there is atomic medicine that can make them feel better, though it does not cure the cancers. This atomic medicine consists of injections, by a newly developed electric injector, of insoluble radioactive chromic phosphate directly into the cancer.

This new palliative treatment was reported by Dr. Vincent Moore of the University of California School of Medicine of Los Angeles.

Atomic medicine is helping fight the spread of cancer from its original location in the body to other regions. Using injections of radiogold, Dr. Colin G. Thomas Jr. of the University of North Carolina School of Medicine, Chapel Hill, N.C., followed its course through the lymphatic vessels of the body. These vesse'ls drain lymph and are best known to the layman when they form lymph nodes, or lymph glands.

Tracer amounts of radiogold injected near accessible cancers of the head, neck and breast, spread rapidly throughout the regional lymph nodes. If a lymph node had been completely replaced by cancerous tissue, radiogold could not be deposited in it. But if even a small amount of lymphoid tissue was still there in the gland, radiogold could get in and be swallowed up in the lymphoid tissue.

A sky blue dye that is rapidly taken up by the lymphatic system where no cancer has invaded is being used by other doctors to determine how far cancer has spread and therefore how much tissue must be cut out at operation. Use of this dye, called direct sky blue, was reported by Drs. Lawrence H. Strug, William Leon and Isidore Cohn Jr. of Louisiana State University School of Medicine, New Orleans.

They inject the dye into the tissues at the time of operation. Within a few minutes they can see where the spread of the dye is checked by the spreading cancer. Much more radical operations than formerly believed necessary should be undertaken, the New Orleans doctors find as a result of use of this blue dye. In cases of stomach cancer, for example, they now find they may have to remove not only all the stomach but part of the pancreas and all of the spleen, in order to remove all the cancer.

How much tissue needs removing to get all the cancer is told by use of another chemical, a dark violet powder known as hematoporphyrin. This chemical is injected into the patient's veins about 24 hours before operation. Then, at the time of the operation, an ultraviolet spot light is beamed on the patient. The cancer tissue glows a bright red, outlining its boundaries and its spread through lymph vessels. Success of this method depends on

using very large doses of the violet powder, Drs. D. S. Rasmussen-Taxdal, Grant E. Ward and Frank H. J. Figge of Baltimore reported.

Use chemical cross fire to attack cancer, is the suggestion from studies reported by Dr. Daniel M. Shapiro of Columbia University. Four drugs used this way showed promising results in cancers in mice. The drugs he used were two vitamin antagonists, a purine antagonist and the male hormone. He selected these because they would block naturally weak nourishment pathways of cancer cells. The lower amounts of enzymes in these weak pathways should be easier to knock out fast, with resultant greater harm to the cancer, Dr. Shapiro reasoned.

Cortisone Helps Sick Cats, Dogs, Horses

▶ CORTISONE, famous gland hormone that has brought relief to thousands of pain-racked bed-ridden arthritis patients, can bring the same relief to dogs, horses and cats afflicted with arthritis.

A six-year-old boxer with such stiff arthritic joints it could not climb was able to run upstairs after one week of cortisone treatment, Dr. John E. Martin of the University of Pennsylvania School of Veterinary Medicine, Philadelphia, reported at a meeting of the American Veterinary Medical Association.

The boxer was only one of many animals helped by cortisone in tests by Dr. Martin and his associates, Drs. Walter E. LaGrange, Frank G. Fielder, Joseph F. Skelley and Maurice W. Arnold.

Besides helping animals with arthritis, cortisone proved effective treatment for otitis externa, an ear infection of dogs, and for skin irritations in dogs and cats, wounds and infection in livestock and acute laryngitis in horses.

Antibiotics Cure Fruit Tree Blight

▶ FRUIT TREES are being protected from the plague of fire blight by antibiotic sprays, the American Phytopathological Society was told by John C. Dunegan, plant pathologist of the U. S. Department of Agriculture.

In the first successful large-scale commercial orchard trial of sprays of mixtures of Terramycin and streptomycin, 98% control of fire blight was obtained in controlled tests at Marysville, Calif.

Fire blight causes annual losses of $70,000,000 and has destroyed pear growing east of the Mississippi. It has made inroads on apple production.

These antibiotics are also being used on hitherto uncured bacterial diseases of tomatoes, peppers, beans, walnuts and potatoes.

For The Home Lab

Mercury

by Burton L. Hawk

► Mercury is one of the most fascinating of the elements. The fact that it is liquid at ordinary temperatures results in rather unusual properties for a metal. To the beginner in chemistry, mercury is ever a source of wonder and amusement.

Mercury is certainly no stranger to the chemist. It was known to the ancient Chinese and to the Egyptians as far back as 1600 B.C. The metal is found free in small quantities, but more abundantly as the sulfide in the mineral *cinnabar,* HgS. It is isolated with relative ease by roasting the ore. Italy and Spain produce the most mercury; however, it is also found in the United States and Mexico. It "freezes" at —39 degrees and boils at 357.25 degrees.

Amalgams

Mercury forms alloys with other metals which are known as *amalgams.* The amalgams of tin, silver, and gold are used for fi'ling teeth. Sodium amalgam is an active reducing agent. You can prepare it by grinding the e'ements together in a mortar. Be sure the mortar is thoroughly dry. Use a drop of mercury no larger than a pea. Cut a still smaller piece of sodium metal into tiny pellets and add to the mercury. Carefully grind the metals together. The resultant sodium amalgam is decomposed by water, forming sodium hydroxide and hydrogen.

If a small quantity of sodium amalgam is added to a concentrated solution of ammonium chloride, slightly warmed, ammonium amalgam is formed but decomposes rapidly. The amalgam swells up and forms a porous mass which quickly disappears.

Compounds

Mercury forms many colorful compounds which are no less interesting than the metal itself. Mercuric chloride (corrosive sub'imate) is one of the most important compounds. It is used to prepare other mercury compounds, also for disinfecting, preserving wood, tanning leather, electroplating, embalming, etching steel and mordanting fur. It is *very poisonous!* It precipitates protein in the cells of the body, usually in the cells of the kidneys. The fatal dose is 0.2 to 0.4 gram. We suggest that you exercise *extreme caution* when experimenting with this compound.

Prepare a moderately strong so'ution of mercuric chloride by dissolving 2 grams in 20 cc. of water in a beaker, heating if necessary. Coo', and add 5 cc. of the solution to an equal quantity of sodium hydroxide solution. A yellow precipitate forms. This is not the hydroxide, but the *oxide,* HgO. The hydroxide decomposes immediately even at ordinary temperatures. Transfer the liquid to a hard-glass Pyrex test tube and allow the precipitate to settle; then carefully pour off the liquid on top. Apply gentle heat

to the test tube until all moisture is driven off. The yellow color will change to orange-red. Now apply strong heat. The oxide will decompose. Oxygen is given off and the mercury sublimes in tiny droplets along the upper wall of the test tube. You can scrape these droplets together by careful manipulation with a glass rod to form a globule of mercury.

Sulfides

Prepare a source of hydrogen sulfide by adding dilute hydrochloric acid to ferrous sulfide in a test tube. Attach a cork and delivery tube. Allow the hydrogen sulfide to bubble through 5 cc. of mercuric chloride solution in another test tube. A heavy white precipitate forms which rapidly turns yellow, brown, and finally black. This is amorphous mercuric sulfide, HgS. The same compound can be prepared by grinding the elements together in a mortar. The red crystalline variety, cinnabar, is formed by sublimation.

Iodides

Prepare a solution of potassium iodide and add a small quantity of mercuric chloride solution. A yellow solution of mercuric iodide forms at first which rapidly dissolves to form the double iodide, K_2HgI_4. Continue to add mercuric chloride until the yellow precipitate forms again. It will rapidly change to red. Upon heating it turns yellow and back to red again on cooling. Filter off and carefully dry the precipitate. Transfer to an evaporating dish and heat gently. The powder will turn yellow and remain so on cooling. Now poke the compound with a glass rod. It will turn red wherever it is touched. Heat mercuric iodide in an evaporating dish and cover with a glass plate. The vapors of the compound will condense on the glass in the form of black crystals. These will also turn red when touched. Sometimes, however, this experiment unaccountably fails. Mercuric iodide can also be formed by the direct union of the elements.

Mercurous nitrate is the only readily soluble mercurous salt. Dissolve a small quantity in a test tube of water. If the solution is cloudy (due to the formation of the insoluble $Hg_2(OH)NO_3$) add a drop or two of nitric acid.

Calomel

Add a little dilute hydrochloric acid to mercurous nitrate solution. The white curdy precipitate is mercurous chloride, commonly known as *calomel*. It is used in medicine as a catharic and diuretic.

When sodium hydroxide is added to mercurous nitrate solution, a dark brown precipitate forms which has been assumed to be mercurous oxide, Hg_2O. However, recent accurate examination has shown the precipitate is actually a mixture of mercury and mercuric oxide.

You can make a "silver" penny by plating it with mercury. Allow a clean sparkling penny to stand in a solution of mercuric chloride for several hours. Remove and dry. The coin will be black. Rub briskly with a soft cloth. The black color will disappear and a silvery lustre will be obtained.

Remember, all mercury compounds are poisonous. Wash your hands thoroughly after experimenting.

Insect Damage to Crops Ends With Harvest and Cold

Battle News From War on Insects

➤ THE INSECT crop-damaging season has ended.

The U.S. Department of Agriculture's economic insect survey section reports that the harvesting of crops and the advent of frost have brought a halt to the active infestation of the nation's crops by damage-causing insects.

Summaries of the damage done this year and forecasts of the possible conditions the nation's farmers might face next year are now being prepared by the section.

In June 1954, the Agriculture Department published the average losses sustained by the nation from 1942-1951 as a result of infestations by more than the 10,000 species of insects that the Department regards as public enemies.

The figures showed that the nation incurred a loss of more than $14,000,000,000 in this nine-year period, or an amount equal to the 1953 budgetary allowance for the running of the U.S. Air Force.

Attacks on fruit and nut crops accounted for a $656,999,000 loss; attacks on vegetable and ornamental plant crops accounted for a $6,648,016,000 loss and attacks on forage and field crops accounted for a $7,397,868,000 loss.

Pattern For Insecticide

➤ BY TAKING apart the insect-destroying principle extracted from the pyrethrum plant, British scientists may be able to make still stronger insecticides.

Understanding the chemical differences that make one substance made from pyrethrum highly poisonous to insects while another harms them much less may point the way to better insecticides, states Dr. L. Crombie of the Imperial College of Science and Technology in London. He described in the scientific journal, *Nature*, his work with pyrethrum, a plant known to medicine since the time of Dioscorides.

In addition to pellitorine, the previously known extract not strongly poisonous, Dr. Crombie has obtained a new substance, anacyclin, from which he has produced an insect poison. Knowing the chemical structure of these pyrethrum products, he believes their differences show the direction in which they can be modified to make artificially insect killers more potent than the original plant.

Flea Beetle Snubs DDT

➤ IN ADDITION to combatting DDT-resistant insects, scientists now have to contend with an insect pest that turns up its nose at leaves sprayed with DDT.

This unexplained ability of the flea beetle to tell which leaf has the DDT was exhibited in experiments conducted by Dr. James B. Kring, an entomologist at the Connecticut Agricultural Experiment Station. The scientist found that flea beetles in laboratory

cages which contained both DDT-sprayed and unsprayed potato leaves, invariably fed upon the untreated leaves.

Dr. Kring uncovered this unique insect ability while attempting to find the nature of the resistance of flea beetles to DDT, which was once highly effective in controlling this important potato pest. The Connecticut scientist also discovered that flea beetles feed much more heavily when the weather is warm.

In the meantime, newer insecticides, such as chlordane, dieldrin and endrin, have proved highly successful in preventing flea beetle damage to potatoes in other tests being conducted at the station.

OK to Eat DDT, Not Nicotine

▸ AMERICANS are now allowed to eat DDT and petroleum oils, but not nicotine or mercury.

Proposed regulations governing the amount of poisonous chemicals remaining on fresh fruits and vegetables without causing harm to the consumer were revealed recently.

The regulations enforce the Miller pesticide chemicals amendment to the Food, Drug and Cosmetic Act, which was signed into law by President Eisenhower this past summer. This amendment literally makes the Secretary of Health, Education and Welfare responsible for polishing the nation's apples.

Designed to protect the public from eating too much insect-killing pesticides, used by farmers in their continuing war against pests, the new regulations set up safety limits for the amount of residue that can remain on a product ready for market.

The safety limits have been tabbed tolerances. A zero tolerance, for instance, would mean that no residue may remain when the fruit or vegetable is sold to the public. Tolerances have been established in parts per million ratio to the food product. DDT, for instance, has been given a tolerance of seven. There is no numerical limit on the scale of tolerances.

The new regulations list 26 tolerances for pesticides now in common use. These tolerances were based on scientific data collected during hearings held in 1950.

The regulations also establish the operational procedure for tolerances to be set on new pesticides, as well as those now in use, but not included in the 26.

No residue of such chemical pesticides as calcium cyanide, mercury-containing compounds of nicotine and nicotine-containing compounds can remain on fruits or vegetables ready for market.

These, in effect, have been given a zero tolerance. However, this does not mean that they cannot be used by the farmer. What it does mean is that fruit and vegetables after harvest must have no chemical residue remaining on them.

Calcium cyanide, for example, although highly poisonous, disappears soon after application and there remains no harmful residue after harvest.

The new regulations also:

Exempt a group of common pesticides which are entirely safe when properly used, such as, petroleum oils and copper compounds.

Establish operating procedures that

make the administration of the new law self-supporting. Application fee for a tolerance rating is $500. Extending an established tolerance to other crops costs another $140.

Sets up a procedure for appealing a tolerance which the manufacturer thinks is unfair.

Under the new law, the Secretary of Agriculture first determines whether a pesticide is useful in agricultural production. Then the Secretary of Health, Education and Welfare must act upon the petition for a tolerance and establish a tolerance.

Zero tolerances are to be set whenever it is found that any amount of chemical residue is unsafe for the public, or where there is insufficient data to establish safety.

Fruits and vegetables distributed through interstate commerce, when found to contain higher amounts of residue than set by the tolerance, will be confiscated by Food and Drug inspectors, aided by their State counterparts.

DDT You Eat Won't Harm You

➤WE EAT some DDT in every meal and store it in our body fat. But the amounts eaten and stored are too small to cause any damage.

Studies showing this were reported by Dr. Wayland J. Hayes Jr., of the Public Health Service's Communicable Disease Center, Savannah, Ga., at the Buffalo meeting of the American Public Health Association.

Restaurant meals and meals in an institution have recently been analyzed for DDT content. The most popu'ar breakfast, lunch and supper offered each day by each restaurant were chosen. Extremely expensive and specialty items were avoided. In each instance a complete, balanced meal was analyzed.

"No meal was found, either in the restaurants or in the institution, which failed to contain some DDT, although some individual food items in the meals were regularly free of the compound," Dr. Hayes stated. "Fatty foods, or foods cooked in fat, tended to contain more DDT than other foods."

An experiment now under way with human volunteers, Dr. Hayes said, shows that dosages as high as five-tenths of a milligram per kilogram of body weight can be taken daily for several months without producing any adverse effect which the person eating this can detect or which can be discovered by laboratory or physical examination.

This is about 200 times the average total amount the average sized man would get in breakfast plus lunch plus supper in the meals analyzed.

The greatest recent advances in our knowledge of DDT, Dr. Hayes said, are those which define the current exposure and the magnitude of tolerable dosages involving this compound which has contributed so significantly to public health and to agriculture. This quantitative information based on human rather than animal exposure should do much to satisfy any reasonable doubts about the safety of DDT.

Chemical Industry Precautionary Labeling Program Reviewed

Read the Label

➤ IN EXPLAINING the need for warning labels on hazardous chemicals, R. D. Minteer of the Monsanto Chemical Company, told a symposium at the 8th National Chemical Exposition in Chicago that although the hazard of a sharp knife is apparent, the hazards of chemicals are invisible and therefore needed identification.

The chemical industry's uniform labeling regulations have become a part of the regulations of five states and the territory of Hawaii since 1949. Illinois became the third state to adopt the labeling regulations in 1951.

The regulations used in the chemical industry are based upon principles developed by the Labeling and Precautionary Information Committee of the Manufacturing Chemists' Association. Mr. Minteer, a member of that committee, said that while the MCA does not initiate regulations, it is available upon request to assist cities and states in drafting labeling codes.

The Committee is cooperating with the Chemical Specialties Manufacturers Association in work on the labeling of household products applying the MCA principles. In this connection, Mr. Minteer told his audience that the important task of educating the public to read warning labels still confronts the industry.

According to an industry spokesman at the exposition a formal program bringing home the importance of "reading the label" will begin soon.

The technical symposium on chemical transportation, packaging and labeling was conducted under the sponsorship of the Manufacturing Chemists' Association, which represents over 90% of the productive capacity of the chemical industry.

Tank Car Specifications

➤ A REVISED and updated set of specifications for railroad tank cars has been submitted to the Association of American Railroads Committee on Tank Cars. T. H. Caldwell, of The Dow Chemical Company, chairman of the MCA Tank Car Committee, said the revised but fundamentally unchanged specifications have been a year in preparation.

They were made up as a cooperative undertaking of industry, the Interstate Commerce Commission, The Bureau of Explosives and the Association of American Railroads. The purpose of the revisions is to bring ICC and AAR specifications in line with modern building techniques and procedures and to make each specification complete in itself to insure clarity of requirements.

Mr. Caldwell also outlined in detail Interstate Commerce Commission regulations regarding the transportation of explosives and other dangerous articles.

He characterized the MCA Tank Car Committee as having one goal—the reduction of hazards in the transportation by tank care of chemical products.

Germ-Made Enzyme Chemical Speeds Recovery From Mumps

Chemicals Treat Children's Diseases

➤ A NEW REMEDY to speed recovery from mumps apparently is at hand. It is a preparation of enzyme chemicals made by streptococcus germs. Its effectiveness in swiftly reducing the painful swelling of the glands in a man with mumps was disclosed in a report by Dr. Joseph M. Miller, chief of the surgical service, Veterans Administration Hospital, Fort Howard, Md.

The man with mumps was one of 64 patients who got the enzyme remedy in a trial of a new way to use it. The other 63 patients did not have mumps but suffered from inflammations due to other infections and also from inflammations and swellings following tooth extractions, bruises, wounds and operations.

The inflammation and swelling were better by the end of the first day of treatment and completely gone by the end of the third day in the majority of the patients. The remedy's score was "excellent" in 45 patients, "good" in 15 and "failed" in four. Of these, three had advanced complicated conditions and one had insufficient treatment.

The remedy is called Varidase, trade name for the preparation of the two strep. germ enzymes, streptokinase and streptodornase. Varidase has previously been used by local application to dissolve blood clots and pus in some surgical conditions.

To overcome inflammation, it is given by injection into the muscles. It acts by breaking down the mechanical barrier that the body sets up in response to injury or infection. The barrier is composed of fibrin clots in the tissue spaces around the injured or infected area. Formation of the barrier is the body's attempt to keep the infection or injury from spreading. Although useful, the barrier also keeps out helpful elements such as red and white blood cells and antibiotics or sulfa drugs. When streptokinase is given, the barrier is dissolved and the blood cells and antigerm medicines can get through.

Dr. Miller stressed that antibiotics or sulfa drugs must be given along with streptokinase to stop any germs in the inflamed area. Otherwise, breaking the barrier would allow germs to spread and thus harm the patient. The man with mumps got achromycin, an antibiotic, along with Varidase.

He was given the treatment for swollen glands under the chin before it was known that he had mumps. The glands on the sides of the jaws had not swollen. But when he developed orchitis the second day, mumps was suspected and a test confirmed the diagnosis.

This patient had been one of a group getting streptodornase, chemically freed of streptokinase.

"Dornase," as it is called for short, did not help him or any of the other patients getting it. The mumps patient was then given the two enzymes to-

gether along with the antibiotic and within three days was practically well.

Object of giving dornase alone was to see which of the two enzymes was the active part of the combination.

Kinase turned out to be the active one but cannot at present be supplied without dornase, because the separation process for isolating pure kinase is so very costly.

A man with face mauled in a fight, another with swollen face and eye swollen shut from sinus infection, others with swellings and inflammation from cellulitis and from bone graft operations were among those helped by Varidase injections into the muscles.

The remedy shows promise also of preventing inflammation and swelling. This feature appeared in the case of a man who had to have many teeth extracted. Those on one side were removed first and his face became very badly swollen. Varidase promptly reduced this. So the remedy was given for three days before the teeth on the other side were extracted. There was only a barely noticeable swelling after that extraction.

Associated with Dr. Miller in the studies were Drs. John A. Surmonte and Milton Ginsberg of the VA hospital and Frank B. Ablondi of Lederle Laboratories, Pearl River, N.Y., manufacturers of Varidase.

Cuts Growth of Viruses

➤ A NEW CHEMICAL that cuts down markedly the growth of mumps and influenza virus in living tissues has been described.

Known as TRB for short, the chemical was tailormade because a very similar compound, called DRB, had previously been found to inhibit growth of 'flu and mumps virus.

Dr. Igor Tamm of the Hospital of the Rockefeller Institute for Medical Research, New York City, reported tests with the two chemicals to the American Association for the Advancement of Science.

Chemically, TRB is 4,5,6-trichloro-1-beta-D-ribofuranosyl benzimidazole.

"It should be emphasized," Dr. Tamm stated, "that TRB is 760 times more active" than the control compound with which it was compared.

When the chemical was injected into eggs previously inoculated with mumps virus, it stopped further growth of the mumps virus almost completely. There was no other effect apparent in the egg tissue.

Whooping Cough Eased

➤ THE WHOOPS of whooping cough are markedly checked, both in number and severity, when children are given the antibiotic, Terramycin.

The decrease in number and severity of whoops shows up by the third day, Drs. Gustav Gavis, Samuel Weinberg, Benj. Newman and Solomon Chazas of New York reported in Washington at the Second Annual Symposium on Antibiotics. The symposium was sponsored by the U.S. Food and Drug Administration and the journal, *Antibiotics and Chemotherapy*.

Vomiting, often a distressing feature in early whooping cough, did not occur after the second day of Terramycin treatment. The children got well faster and there were no secondary bacterial complications.

Terramycin is also helping children with the kidney disease, nephrosis. It can be safely given over long periods of time and acts as a highly effective prophylactic in preventing pneumonia and streptococci infections which are most feared complications in children with nephrosis. The results of this use of Terramycin were reported by Drs. Harriet G. Guild and Don C. Petersen of the Johns Hopkins Hospital, Baltimore.

Snail Chemical For Whooping Cough

➤ SEARCH for new antibiotics to cure human diseases has ranged from molds, fungi, soil bacilli and higher plants to such things as slugs, snails and—well, probably not puppy dogs' tails.

Snails, however, have yielded a chemical called helicidine claimed to be a specific remedy for whooping cough. The claim is made in a patent issued by the U. S. Patent Office, number 2,686,144, to Fidel Gonzalez-Barcena y Fonsdeviela of Madrid, Spain. The patent is for a process for producing helicidine from "living molluscs of the helicides type."

Molluscs are members of that animal division that includes snails, slugs, mussels, oysters and clams. The helicides type would be the snails.

Mushroom Antibiotic in Yellow Light

➤ AN ANTI-GERM CHEMICAL, or antibiotic, can be gotten from mushrooms if extraction and purification is done under a yellow light in a dark room.

This secret to success in getting the mushroom antibiotic was announced by Nancy Atkinson, bacteriologist at the University of Adelaide, South Australia, in the British scientific journal, *Nature*.

She had discovered the antibiotic chemical in an edible mushroom back in 1946. But it was so unstable that she was "defeated" in attempts to concentrate and purify it and when the mushroom supply ran out, she temporarily abandoned the work.

This year, she reports, there was a good supply around Adelaide of the particular mushroom, Psalliota xanthoderma. So she started work again on purifying the antibiotic, using paper chromatography of water extracts of mushroom stems. The amount of activity on the paper, she found, depended on the extent of exposure to daylight during the work.

After experimenting with various light sources, she found that a Philips yellow dark room globe was most satisfactory. Work testing the antibiotic against various disease germs to determine its potential future usefuless as a remedy is now going forward.

The new antibiotic, Miss Atkinson thinks, can now "justifiably and conveniently" be named psalliotin.

Future Corn Cobs Nutritious For Bossy

Food Resources Expanding

➤ NUTRITIOUS CORNCOBS may be among the cattle feeds of the future. Improved corn is already trending in this direction.

Corncobs today have more pentosan, a substance somewhat akin to sugar, and less woody lignin than they did some years ago. There is evidence that this tendency has been built into corn evolution.

Watching the development of improved varieties of corn from the Northern Regional Research Laboratory, Peoria, Ill., one of the research laboratories of the U. S. Department of Agriculture, Dr. R. T. Milner, its director, sees this coming development forecast in the records his laboratory has built up over a number of years.

Along with the sugar of sweet corn and the starch of the mature grain, the corn plant builds pentosans into the ear of corn, concentrating it in the cob. Each chemical unit of pentosan contains five carbon atoms, instead of the six found in both starch and sugars. A slight rearrangement of the structure would result in pentose sugars, which would help feed and fatten cattle.

Cud-chewing animals, including cattle, are equipped with special micro-organisms in their multiple stomachs which can break down cellulose and related chemicals so that the animals can digest them. Pentosans are among the chemical types that these micro-organisms can use. If the percentage of pentosans keeps increasing, bossy may be even more contentedly chewing up her corn, cobs and all, in only a few years' time.

Chemists at the present time rearrange the pentosan molecule in a somewhat different way to produce furfural, a useful material from which they concoct, among other things, nylon. But there is plenty of organic material going to waste from which furfural could be produced. We need not see immediate rivalry between cattle feed and ladies' hosiery.

Plant geneticists are at the present time developing new kinds of hybrid corn constantly, to increase one or another of the useful by-products of this important food crop. A little more attention to selecting new varieties for the pentosan yield of their cobs may result in still more useful tonnage from the corn crop, and less waste of a major agricultural resource.

Cheap Amino Acid Source?

➤ WANTED: an animal which can eat molasses and ammonia and produce beefsteak.

This is the goal of sugar chemists as described to a recent meeting of the U. S. Beet Sugar Association by Dr. Henry B. Hass, president of the Sugar Research Foundation.

Meat, three to 30 times as expensive as sugar, supplies the body with amino acids, which are essential to

growth and health. Some of these can be produced artificially by chemicals, but two of them, lysine and tryptophan, have not been produced by any cheap artificial method, Dr. Hass said. If these could be produced by some yeast or enzyme from surplus sugar crops or the wastes that accompany production of sugar, "it will be possible to feed the people of the world adequately for the first time in human history," Dr. Hass believes.

Noting the chemical products already on the market from sugar crop by-products, Dr. Hass points to a potential "sucrochemical industry" from this source, just as the petrochemical industry has sprung in recent years from chemical development of petroleum products.

Food Outruns Population

➤ WORLD FOOD production is rising faster than population increase for the second season in succession, the Food and Agriculture Organization of the United Nations has determined.

There are surpluses in some regions and continued shortages and widespread malnutrition in others, the FAO warns. Two problems in particular are matters of serious concern to the FAO:

1. How to reduce existing surpluses without unbalancing the trade in agricultural commodities.

2. How to insure continued agricultural expansion, on a selective basis, as regards countries and products, so as to improve world nutrition as a whole.

While surpluses that exist principally in North America are chiefly concerned with grain, the rise in total agricultural production is greatest in Western Europe and the Near East, with smaller gains in the Far East and Oceania. Food production expanded faster than population in all the less well-fed regions except Latin America.

Your Nose is a Chemical Analyzer

➤ YOUR NOSE is a chemical analyzer. If you sniff a mixture of odorous substances, after a little study you can name the substances that make up the mixture.

This result of an experiment conducted by Drs. Lloyd H. Beck, James J. Stoven and John J. Doyle of Yale University, was reported to the American Psychological Association. The experiment was tried on 112 persons, some of whom were children.

The odor of the mixture, it was found, can be analyzed by the nose when the odors are familiar or unfamiliar, when the material smelled was a liquid or a gas and when either one or both nostrils are used.

In this respect, the nose performs like the ear which can hear the separate sounds making up a chord. It is unlike the eye. When you look at a mixture of yellow and blue, you see green, not a combination of yellow and blue.

Non-Wovens Are Newest Textiles

No Warp, No Woof

Reprinted from the INDUSTRIAL BULLETIN *of Arthur D. Little, Inc.*

▶ THE RECENT development of fibrous rubber sheeting illustrates advances in the technology of non-woven fabrics.

Most non-wovens are essentially films of fibers that are bonded together, rather than interlocked like the fibers in a paper sheet.

Use of such fabrics, predominantly those from cotton, rayon, and mixtures of the two, has grown from a few thousand pounds per year in 1945 to over 25 million pounds in 1953.

Present applications depend largely on softness and absorbency, but these fabrics can be engineered to produce desired characteristics through use of new synthetic fibers and bonding agents, and many new applications are expected.

Non-woven fabrics, which now account for one per cent of the textile market, are generally produced from fibers ranging from three-eighths of an inch to an inch and a half in length.

In one process, these fibers are untangled and carded, or combed, into a loose web; the newly-laid mat is then drawn over a series of cylinders.

With thermoplastic fibers, one of these cylinders is heated to provide a surface where bonding may take place as the mat passes over it; if solid or liquid bonding agents are used, they are applied just before cylinders that provide simultaneous heat and pressure.

To produce the many types of non-woven fabrics possible, a wide variety of web handling and bonding techniques is employed.

For example, the web can be passed through an adhesive bath to impregnate the entire fabric with resin. Or the web first may be wetted to preserve its strength and then "printed" with resin in a pattern.

The areas not so printed retain the softness of the untreated web, and the printed areas may be colored, by using special adhesives, for ornamentation.

Through suitable handling, as for example by depositing with a blower, the fibers in the resulting mat will be more randomly arranged, with little streaking and reduced tendency to tear in a preferred direction.

If the fibers are themselves elastic, as in the case of rubber, the fabric can really be said to have two-way stretch. Randomly-oriented non-wovens now account for less than 10 per cent of the total non-woven market, but they are being studied increasingly.

Although they are generally more expensive than the oriented type, their inherent possibilities of greater strength may be important for increased acceptance.

Advantages of the non-wovens include light weight, smooth surface,

high porosity, softness, and low price with respect to regular fabrics. For these reasons major uses are as disposable and sanitary cloths.

One cleaning cloth made of bonded fibers relies on these characteristics, plus a combination of water-absorbency and dirt-repellency. Dirt taken into the pores of the fabric is easily washed out.

Other applications are found in medical and dental napkins, dairy filters, shoulder pads, stiff petticoats, and the like—the stiffer materials using the fully-impregnated fabrics.

Strictly speaking, non-woven fabrics are not radically new, but represent the application of a different technique to familiar fibers.

Thus cotton, rayon, nylon, Dacron, dynel, Orlon and the new rubber mat are all in use, and other newer fibers are expected to contribute heavily to expansion.

The most common bonding agents are vinyl and acrylic resins, regenerated cellulose, or latex products; again newer materials are expected to be important to further development.

To date, most non-wovens are tailored to specific end uses; one manufacturer reports over 800 types.

Prices range between those of high-grade paper and of medium-quality woven fabric.

New uses for the non-wovens will depend upon characteristics built into the fabric through proper choice of fibers, bonding agents, and processing techniques; the outlook is for steady growth based upon continuing fabric research.

Bubbles Cause Volcanic Eruptions

➤ TINY BUBBLES cause volcanoes to erupt.

This new theory is advanced by Dr. George Kennedy, geophysicist of the University of California at Los Angeles.

Dr. Kennedy believes that explosive volcanic eruptions are due to sporadic formations of groups of very tiny bubbles in molten lava. The rapid propagation of gas bubbles in lava is a process of rapid expansion typical of all explosions.

The traditional concept of explosive eruptions is that as lava solidifies around the chamber of the volcano, water is confined in an increasingly smaller area. When the pressure of the water becomes greater than that of the lava shell an explosive eruption occurs.

This theory would account for only one explosive eruption, Dr. Kennedy points out, for once the shell explodes the whole system is shattered. The new theory of bubble nucleation would allow for a series of vio'ent explosions over an indefinite period.

Much of Dr. Kennedy's theory has been worked out in studies of critical bubble size in a beaker of water. By simulating some of the conditions in volcanic eruptions he has been able to make a beaker of water "explode."

Valueless Jewel Good For Industrial Polishing

Garnet Abrasives

Reprinted from FOR INSTANCE, *American Cyanamid Company.*

SERENDIPITY, no doubt, is an active ingredient of many success stories. "The faculty of making happy and unexpected discoveries by accident" is the definition of serendipity in the Oxford Dictionary.

However, accidental discoveries rarely happen where no previous thought was given to the subject matter or where keen observation is lacking and perseverance is insufficient to assure success.

Something more than serendipity was required to convert the discovery of a ruby-colored stone by a lumberman at North Creek, N. Y. in 1865 into the largest garnet abrasive company in the world today.

The lumberman showed his stone to a jeweler in Boston who realized it was a form of garnet which had little value as a gem but—could it be crushed and used as an abrasive?

He knew that garnet was both hard and tough. When he powdered it he found it always fractured into particles having sharp cutting edges.

In this respect it was far superior to powdered glass, emery, and flint used as abrasives on sandpaper. Incidentally, sand is almost never used for sandpaper.

Garnet abrasives are used for precision grinding of plate glass and optical lenses, sanding choice woods for fine furniture, and a thousand-and one other industrial grinding and polishing processes.

At first, operations at North Creek were the pick and shovel type but today modern mining machinery is converting a section of Gore Mountain into a variety of garnet abrasives with great efficiency.

After crushing and grinding, the garnet is separated from the associated hornblende rock by mechanical, heavy media, and flotation processes.

The crushed ore is washed and separated into a range of particle sizes by passing it through screens. Heavy media separation is based on the fact that light objects float on heavy fluids and heavier objects sink.

The problem of finding a fluid heavy enough to float the unwanted rock may appear to be stupendous. However, suspensions of finely ground ferrosilicon or magnetite in water may be adjusted to the required specific gravity and have been used successfully as heavy media in the mining industry for many years.

By this method the lighter rock is separated from the heavier garnet and the ferrosilicon or magnetite is recovered by magnetic separators.

The flotation process recovers garnet from particles too fine to be handled by the heavy media process. Two interesting chemicals are used in the flotation process: promoters and frothers.

The promoter is added to a water slurry of the finely ground ore then the frother is added and air is beaten

into the mass. The froth adheres only to the particles selected by the promoter, therefore these are carried off in the froth.

When closely related minerals are present it may be necessary to add a selective depressant to prevent the air bubbles from adhering to a particular constituent.

A wide range of promoters, depressants, frothers, and other reagents are available for efficient separation of many minerals by the flotation process.

Garnet deposits have been found in several States but usually gem garnets are imported from Ceylon, Burma, Bohemia, and Madagascar.

There are many varieties of garnet which range in color from white to black and include the blood-red pyrope, orange essonite, pink grossularite, purple rhodolite, and green demantoid.

Chemically they are silicates of two or more of the following metals: iron, aluminum, calcium, chromium, titanium, and manganese.

Research has produced the red manganese-aluminum garnet by fusing salts of these metals at temperatures about 1650°F under the very high pressure of 450,000 pounds per square inch.

Such laboratory experiments indicate the temperature and pressure conditions which existed in the earth's crust when the natural deposits were formed.

The smooth surface and brilliant polish on plate glass, optical lenses, or fine furniture seem totally unrelated to red stone on Gore Mountain. And indeed there are many skills and much serendipity operating between these and similar extremes, but of such is civilization.

Outdoor Laboratory for Drainage Problems

➤ A LABORATORY "as big as all outdoors," the Oxnard plain of Ventura County in California, is being used to study soil drainage problems of salt marsh areas.

The research is being performed by J. D. Isherwood, Prof. M. R. Huberty and Prof. A. F. Pillsbury of the University of California at Los Angeles' department of irrigation and soils.

Much of this rich farming area, which now grows beans and citrus fruits, was originally saline and of low economic value because of the nearness of the ground surface to sea level, with a high water table over a sub-surface "clay cap."

The area was reclaimed by local farmers by trial-and-error methods. The U.C.L.A. research primarily involves testing of new tile drainage theories now being developed in the field on existing systems.

The water table is being observed by means of a network of small diameter wells. These indicate that, except for periods immediately following storms, the water table is actually higher during the summer than in the wet winter season. This is probably due to extensive summer irrigation.

Active Prospecting Locates More Fissionable Materials

Foreign Sources of Uranium

Excerpts from remarks prepared by Rafford L. Faulkner, Assistant Director for Foreign Procurement, United States Atomic Energy Commission, For Delivery Before Third Annual Conference of National Industrial Conference Board on Atomic Energy in Industry October 13, 1954, New York, N. Y.

▸ When the Atomic Energy Commission began to function in 1947, the bulk of our uranium was coming from the Congo, some was being produced in Canada, and an almost insignificant quantity was being mined from our western carnotite deposits. It was obvious that most of our eggs were in one basket. Hence, long-range programs were undertaken to increase domestic and Canadian production and bring into being additional foreign sources. An added push was supplied by the decision of Congress in September, 1950, to expand the production of fissionable material. Later, in June, 1952, Congress authorized a huge additional expansion which raised total eventual plant investment to between $8 and $9 billion.

The United States' search began in earnest early in 1948 when the new Atomic Energy Commission announced that it would buy from domestic sources all of the uranium produced during a given period at guaranteed minimum prices. At the same time, it established an active program of exploration to find new deposits, undertook geologic studies and assisted and encouraged private interest in this new field. The infant uranium mining industry—it is only about six years old—is healthy and growing fast to meet defense requirements. Its recent spectacular growth is due almost entirely to the activities of private industry.

Simultaneously with the initiation of a domestic program, a vigorous effort was begun to develop new uranium production abroad. This effort is now paying off.

Uranium in Canada

Before discussing the overseas sources of uranium I should like to note that, stemming from their wartime partnership on the atomic bomb project, Canada has continued in its close association with the United States in expanding uranium production. Canadian governmental activities and widespread participation by private enterprise in developing new sources of supply are enabling Canada to make a firm bid for first place in world uranium production.

In the development of overseas sources of uranium production, the United States has been fortunate in having the active participation of the United Kingdom. Early in World War II during the development of the first atomic weapons, the United States and the United Kingdom joined in the uranium procurement effort. These joint procurement activities are carried on through the

Combined Development Agency, directed by members appointed by the Government of the United Kingdom and by the United States Atomic Energy Commission.

The Agency's first procurement arrangement was made during the war with Union Miniere du Haut-Katanga through the Belgian Government in exile for procurement of uranium from the Shinkolobwe mine in the Belgian Congo. Since the beginning of operations in 1922, this mine has been the world's most important individual producer of radium and uranium. It has been the mainstay of our atomic energy program and without it we could not have come so far so fast.

Belgian Congo Mine

At Shinkolobwe, the ore occurs in irregular veins and high-grade bunches in or associated with steeply-dipping quartzites. Although a large amount of ore has been mined from the surface in an open pit, it is now being extracted entirely from underground workings. Early shipments were of hand-picked ore containing 50 to 60% U_3O_8.

Union Miniere has recently completed construction of ore processing facilities to utilize the lower grade ores available, and has undertaken an extensive exploration and mine development program. It is too early to assess the full effect of this work on long-range productivity, but additional ore is being found and only a pessimist would predict the early exhaustion of this great mine.

In South Africa

The story of South Africa's uranium actually began about 1923 when uraninite was identified in the Witwatersrand gold ores. The small uranium content made the identification of no more than academic interest until 1945, when the Manhattan Engineer District, predecessor to AEC, made a survey to see whether uranium might be economically recovered from these ores. Information on the distribution of uranium within the gold-bearing reefs and in accumulated slime dumps was scanty, but a major sampling program was undertaken to determine whether, subject to the development of a satisfactory treatment process, the deposits were capable of supplying important quantities of uranium for our program.

As early as March, 1946, before it was possible to evaluate production possibilities, research was begun in Government laboratories in the United States, the United Kingdom, and South Africa on the development of an economic process to recover the relatively small quantities of uranium present in the go'd ore tailings. By the fall of 1949 sufficient data had been collected to provide a basis for an understanding, which was replaced a year later by an agreement for the production and sale of uranium concentrates. Meanwhile, research was beginning to supply some of the answers. Pilot plants were built to test the information coming out of the laboratory.

Gold Ore Process

The combined research efforts developed a uranium recovery process which is technically and economically sound. It begins where normal gold recovery operations end. The ore which has been mined, hoisted, crushed, ground, and cyanided to remove the gold is then pumped to the

uranium plant where the uranium is dissolved from the rock with dilute sulphuric acid. In contrast to the ores of the Colorado Plateau, where one ton of ore will yield several pounds of uranium, several tons of South African gold tailings must be leached to yield one pound of uranium.

The initial agreement called for the construction of six leaching plants having an aggregate annual capacity of about 7 million tons of gold ore residues, to be drawn from the operating gold recovery plants and supplemented by accumulated tailings. Although the South Africans considered this an ambitious undertaking in view of Industry's concern with shortages of skilled labor, water, and power, the program has since been greatly expanded.

New Plants Operating

First production in South Africa began in October, 1952. Now there are six plants in production with a number of others nearing completion. When all of the facilities authorized or planned are completed, uranium for defense will be coming from fifteen to sixteen plants in the Transvaal and Orange Free State, drawing tailings from 23 to 24 operating gold mines as well as from some accumulated slimes dumps. Total cost, together with auxiliary facilities such as sulphuric acid plants, is estimated at close to $190 million. These plants have been financed by loans, two-thirds by the United States through the Export-Import Bank, and one-third by the United Kingdom through the Ministry of Supply.

There are few countries in the world where an undertaking of this magnitude could have been so rapidly and effectively carried forward. The South African mining and construction industries have done a magnificent job.

South Africa has gained an important new industry and we have gained a new substantial source of by-product uranium at a cost comparable to that being paid for uranium recovered from conventional ores.

The gold mines from which uranium is to be produced, for the most part calculate their reserves in terms of 30 to 40 years of operating life. However, past exploration in South Africa has been primarily devoted to the search for gold. Some reefs have already been identified which, while too low grade to be worked for gold alone, can be mined when income from uranium is taken into account. There is no doubt that other such occurrences will be found. Further, improved recovery techniques will bring uranium production from sources now considered too low grade to work. It is safe to predict that South Africa will be a leading producer of uranium for many decades.

Two Sources in Australia

In Australia, two productive enterprises are already under way. First from the standpoint of discovery was an occurrence of uranium at Radium Hill in the State of South Australia which was first prospected some years ago as a possible source of radium.

At Radium Hill uranium is found in davidite, a refactory titanium rare earths uranium mineral occurring in steeply-dipping fissure veins up to several meters wide. It has been found persistent both horizontally and in depth, the deepest drill hole intersection to date being about 1600 feet.

Treatment problems have been successfully worked out and uranium production will begin with the completion of ore processing facilities early next year.

A more recent discovery at Rum Jungle in the Northern Territory has perhaps received more publicity. Here the principal uranium mineral is uraninite associated with both oxide and sulphide copper minerals. These ores respond to normal extraction methods but treatment facilities will also provide for copper recovery. This project, managed for the Commonwealth Government by a subsidiary of the Consolidated Zinc Corporation, began initial operation last month and, as in the case of Radium Hill, will soon be furnishing uranium for defense.

Australian activities in the field of exploration and development are now gaining momentum. The Commonwealth Government announced in June of 1953 a five-year period of guaranteed prices using a price scale similar to that in effect on the Colorado Plateau. Reports of new finds are frequent and more and more companies are putting prospecting crews in field. Published reports indicate that some of the newly discovered occurrences may become important producers.

New Finds Expected

Although there is no present basis on which to predict the magnitude of the contribution Australia may be able to make in terms of uranium for future nuclear power, one could expect that the pattern would be similar to that developed in the United States and Canada, where active search by a large number of people has already resulted in production levels far higher than anyone was willing to predict a few years ago.

To complete the foreign uranium production picture I should mention the Urgeirica mine in Portugal operated by a British-owned company. Uranium deposits in Portugal have been sporadically worked for uranium for many decades and a large number of uranium occurrences are known. The Urgeirica and nearby properties have, for the past several years, accounted for minor uranium production in terms of the Free World's requirements. There is little doubt that active prospecting and development would disclose a number of commercial deposits containing in the aggregate thousands of tons of uranium. . . .

Future of Thorium

Nothing has so far been said about thorium, which may become important as a source of atomic fuel. Thorium has not occupied a position of primary importance in our program and for that reason the effort to develop new sources of supply has not been comparable to that expended in the search for uranium.

The historic source of thorium has been monazite mined primarily for rare earths. A future continuing demand measured in terms of hundreds of tons of thorium yearly should not be too difficult to meet from the development of known sources of supply such as the monazite sands of Travancore in India, the Brazilian monazite deposits, the South African monazite vein deposits, and the monazite sands of Idaho and the southeastern United States.

However, continued production at these levels from monazite might command higher prices than currently quoted for by-product thorium compounds, since the thorium might have to bear most of the mining and processing costs unless an expanded market for rare earths is developed. Thorite and thorianite deposits are also known which may become future sources of the metal. Further, by-product output of thorium in connection with some uranium deposits is a distinct possibility.

The fact that new potential sources of thorium are from time to time reported, despite lack of emphasis on the production of this material, suggests that an even larger demand could be supported if sufficient lead time were given and a vigorous effect were made to develop new sources of supply.

Shock Tube Probes Stellar Atmosphere

▶ SHOCK TUBES which are being used so successfully to design guided missiles for jet planes, are giving astronomers real clues about what is going on in the atmospheres of stars.

Reports by University of Michigan physicists on this unexpected application of a laboratory instrument widely used by aeronautical engineers were a highlight of the conference on stellar atmosphere at Indiana University, Bloomington.

Using a shock tube, the scientists are duplicating in the laboratory under known conditions temperatures found in our sun and other stars. The astronomers, specialists in stellar atmospheres, known as astrophysicists, are excited by prospects of what they can learn for the first time with this instrument.

In the shock tube a shock wave is set up when a gas at very high pressure bursts into a chamber containing a gas at very low pressure. For a bare fraction of a second, two microseconds, the gas behind the shock wave reaches such high temperatures, about 15,000 degrees Kelvin, that it makes its own light. Aeronautical engineers are using such shock waves blasted against model missiles and jet planes to check on their stream lining.

The Michigan physicists are looking at the self-luminescent gas with a spectrograph, an instrument that splits light into its many components. They use the spectrum so obtained to get the identity and intensity of the chemical elements present.

In this way they can get clearer pictures of what happens in the high temperature gas than they can by examining light from far away stars which are made of gas of very high temperature. Only hydrogen and helium at the high pressure end of the high shock tube and xenon and argon at the low pressure end have been used so far.

The scientists hope in the future to get spectrograms of other elements by introducing them into the shock tube. They also hope to determine the ratio of the intensity of the several spectral lines of these various elements. The research was done by Drs. E. B. Turner and Alan C. Ko'b.

Materials and Processes Based on Chemical Knowledge

Patents on Chemical Themes

To obtain a copy of any U.S. patent, order by number from the Commissioner of Patents, Washington 25, D. C., enclosing 25 cents for each patent ordered. Send money, P.O. money order, or Patent Office coupon, but do not send stamps.

Solar Heat Trap

➤A SOLAR FURNACE, perched atop your housetop, that also can double as a summer air conditioner won patent No. 2,680,437 for Kenneth W. Miller of Chicago, who assigned his rights to the Board of Regents of the University of Colorado.

Using glass shingles arranged in venetian blind fashion, the solar heat trap is aimed at collecting the warmth in sunlight and distributing it throughout a house. It is particularly designed for areas where heating fuels are expensive and sunlight is plentiful.

With auxiliary refrigerating or dehumidifying equipment, the heat trap can be put to work as an air conditioner. The glass "venetian blinds," which are encased in a glass box, are covered on one side with a highly reflective metallic foil that is cemented on the glass with a jet-black, heat-absorbing adhesive, such as lamp black in shellac.

Mr. Miller says the device can generate temperatures of 300 degrees Fahrenheit at a comparatively high efficiency of energy conversion, thus making it suitable for some industrial uses where gases must be heated.

Cooler For Jet Engines

➤AN OIL COOLER for jet engines has been especially designed for planes that must fly for long periods of time.

Invented by Pasquale A. De Padova of Newark and Vincent Condello of Teaneck, N. J., who assigned their patent No. 2,680,433 to the Air Force, the device eliminates the need for carrying excess oil, which must be expended to keep the engine running properly, or heavy cooling equipment which is the alternative to carrying extra oil.

Instead, the new device admits gasoline to the oil supply and circulates the oil-gasoline mixture through the parts that must be lubricated. The hot oil returns to a vacuum chamber where the gasoline evaporates, carrying off much of the heat the oil picked up. Only a small quantity of gasoline is required, and the overall weight of the system should not penalize the plane's fighting ability.

Fire Extinguisher

➤A FIRE extinguishing system that uses dry chemicals instead of water promises to do less damage in some factories and stores where water can be as destructive to stock and merchandise as a small fire.

The device can be hooked to sprinkling systems or to pipelines which feed fire hoses. A dry chemical powder is stored in a tank and is blown out when needed by compressed gas. In-

vented by Arthur H. Guise of Marinette, Wis., the device won patent No. 2,681,115. Rights were assigned to Ansul Chemical Company, also of Marinette.

Phono Record Material

➤ BETTER phonograph records may be in the offing as a result of a plastic-wax material that makes high-fidelity reproductions of a master record and remains in "satisfactory" condition even after 500 playings.

The material was worked out by Frazier Groff of Plainfield, Peter B. Potter of Martinsville, and Robert W. Smith of Morristown, N. J., who assigned their patent, No. 2,681,323, to Union Carbide and Carbon Corporation.

It is a polystyrene plastic made less subject to needle wear by waxes such as carnauba, beeswax and cotton wax. Whale oil, sardine oil, castor oil, cotton seed oil and soya bean oil also can be treated chemically to make suitable synthetic waxes for the mixture.

Color TV Projection

➤ THERE MAY BE no problem in projecting future prizefights televised to theaters in color.

Richard K. Orthuber of Fort Wayne, Ind., received patent No. 2,681,380—and assigned it to the Air Force—on a projection system he devised.

Instead of having a phosphor-coated screen, his color TV projection tube has a lattice-like mosaic of tiny metallic leaves. Electrons beamed at this screen charge the little leaves negatively, causing them to deflect toward a positive plate.

Powerful projection lights, red, green and blue, shine on the mosaic. Each leaf reflects a spot of light into the projection lens. The brilliance of the spot depends upon the position of the leaf. The tube screen is discharged after each frame has been "drawn" upon it by the moving electron beam.

New Die Increases "Size"

➤ A NEW DIE has been invented that steps up the "size" of a sheet-metal extrusion press without requiring costly revamping of the machine.

Promising to be a boon to makers of airplane "skins," aluminum and magnesium alloys are squeezed through the new die and emerge as U-shaped sheets. The metal then is straightened out into flat sheets far wider than the press could have produced normally.

Patent No. 2,681,734 went to inventor Karl F. Braeuninger of Gundernhausen, Germany. He assigned it to the U. S. Air Force.

Fuel System For Turbines

➤ A DUAL-FUEL system for feeding gas turbines has been designed to help insure the commercial success of this new type of power plant.

Arne Loft of Schenectady, N. Y., who assigned patent No. 2,681,694 to the General Electric Company, provides for a regular fuel oil, known as Bunker C, and a reserve supply of ordinary diesel oil.

Should something happen to the Bunker C fuel system, diesel oil is immediately fed to the turbine to avoid excessive temperature rises or "thermal shocks," both of which can be seriously damaging to these machines that operate almost at the limit of the metal's heat-resistance.

An accumulator stores a reserve supply of diesel fuel which it will feed to

the turbine in the event that both fuel systems are "killed" at once—say by a temporary electric power failure. The gas turbine will run for about a minute on the fuel stored in the accumulator.

Purifying Iron Ore

➤ A METHOD of getting zinc, nickel, copper and cobalt out of iron ore by using a chlorinating salt won patent No. 2,681,855 for Tor Fjalar Holmberg of Imatra, Finland, who assigned his rights to Osakeyhtio Vuoksenniska Aktiebolag, a joint-stock company of Imatra.

"Bullets" of iron ore and a chlorinating salt, such as calcium chloride, are molded into balls less than an inch in diameter. They are fired in a furnace at 400 to 575 degrees Fahrenheit to drive off the water of crystallization in the chlorinating salt. Then the bullets are put in a reducing atmosphere furnace. They will withstand high temperatures in the reaction furnace without fusing with one another.

This ore treatment has been unsatisfactory previously, the inventor says, because the metal lumps melt and fuse. This was attributed to the water of crystallization held by the chlorinating salt.

Sandwich Stops Oxidation

➤ A WAY has been found to stop the oxidation of strategic molybdenum and tungsten parts of hot machines such as jet engines and gas turbines. The metals are sandwiched in aluminum and can withstand temperatures as high as 3,600 degrees Fahrenheit.

The process won a patent for inventors Marshall G. Whitfield and Victor Sheshunoff, both of Garden City, N.Y., who assigned their rights to Whitfield & Sheshunoff, Inc.

Parts made of tungsten and molybdenum alloys are "theoretically promising" in industry, the inventors report, but have proved "very disappointing" in general practice. Both metals oxidize in air so rapidly that the part's life expectancy may not exceed 300 hours. Some critically important structural elements would have to be replaced frequently at great trouble and expense.

By hot-dipping the alloys in molten aluminum, a protective jacket is applied that guards the metal from oxidation at high temperatures.

Metal Continuously Cast

➤ INGOTS of aluminum and magnesium can be continuously drawn from a bottomless water-cooled mold that has been especially designed for no-interruption casting.

The new molding technique permits many ingots to be cast at once and slowly withdrawn as the metal hardens. Molten metal is siphoned from a master reservoir into individual molds in proportion to the speed at which the hot ingots are emerging. The siphons can be instantly stopped and started if "semi-continuous" casting is preferred to continuous casting.

Invented by William T. Ennor of Oakmont, Pa., and Arthur C. Heath Jr., of Massena, N. Y., who assigned patent No. 2,683,294 to the Aluminum Company of America, the gentle action of the siphons eliminates faulty ingots that often are produced when metal is squirted into molds. The siphons permit the molten metal to flow into the molds smoothly without carrying air which can oxidize the metal.

Book Condensations

Isotopic Tracers: A Theoretical and Practical Manual for Biological Students and Research Workers—G. E. Francis, W. Mulligan and A. Wormall with a foreword by G. Hevesy—*University of London*, 306 p., illus., $7.00. Intended as a practical manual for use in the laboratory rather than the library.

Progress in the Chemistry of Fats and Other Lipids: Volume 2—R. T. Holman, W. O. Lundberg and T. Malkin, Eds.—*Academic Press*, 347 p., illus., $9.80. Digests of recent advances contributed by specialists in the field.

Textbook of Biochemistry—Benjamin Harrow and Abraham Mazur—*Saunders*, 6th ed., 563 p., illus., $6.50. Containing many revisions and a new chapter on the metabolism of nucleoproteins as well as new material on timely topics such as chromatography.

Branched Molecules—F. R. Eirich and others—*New Academy of Sciences*, Annals, Vol. 57, Art. 4, 135 p., illus., paper, $3.50. Dealing with the class of nonlinear polymerizations that may lead to infinite network structures.

The Optical Ptoperties of Organic Compounds—Alexander N. Winchell—*Academic Press*, 2d ed., 487 p., $12.00. In this edition more than 2500 substances are described.

Organic Chemistry—A One-Semester Course—Lawrence H. Amundsen—*Holt*, 368 p., illus., $4.75. For the student who does not intend to prepare for chemistry as a profession.

The Structures and Reactions of the Aromatic Compounds—G. M. Badger—*Cambridge University Press*, 456 p., $11.50. Devoted to this whole group of compounds. Nearly all dyestuffs are aromatic as are most of the common drugs and explosives. For graduate students and chemists.

Symposium on Fluorescent X-Ray Spectrographic Analysis—E. B. Ashcraft and others—*American Society for Testing Materials*, 68 p., illus., paper, $1.75. In recent years, improvements in the generation of high intensity X-ray beams and in means for measuring them made the X-ray method feasible for quantitative analysis.

Index to the Literature on Spectrochemical Analysis: Part III, 1946-1950—Bourdon F. Scribner and William F. Meggers—*American Society for Testing Materials*, 226 p., paper, $4.50, all three parts, $7.50. This part brings the total of references up to 1,264. Listed chronologically and alphabetically by first author's name.

Estimation of Available Phosphorus in Soils by Extraction With Sodium Bicarbonate—Sterling R. Olsen, C. V. Cole, Frank S. Watanabe and L. A. Dean—*Govt. Printing Office*, USDA Circular No. 939, 19 p., illus., paper, 15 cents. A new method is here described.

Inorganic Quantitative Analysis—Carroll Wardlaw Griffin—*Blakiston*, 2d ed., 417 p., illus., $4.75. A textbook with the emphasis on thoroughness.

Proudly Presented

➤ HEXAVALENT chromium, which causes trouble in chromium plating cycles, is combatted by Chromekill 4A, marketed by Enthone, Inc., 442 Elm St., New Haven, Conn.

➤ PRECISION milling of aircraft and guided missile parts without machinery can be accomplished with the new chemical milling process developed by North American Aviation to save weight, give greater accuracy and permit better designs.

Through arrangements with North American, Turco Products, Inc., of Los Angeles, is licensed to make the process available to other manufacturing companies.

Chemical milling was developed by the Materials Research and Process Group of the Aerophysics Department at North American's Downey, California, plant.

Chemical milling is not intended to replace all machining operations but to permit new, unconventional designs. Cost of chemical milling equipment is only a fraction of that for a skin mill.

To prepare a part for chemical milling, the metal to be removed is left exposed, while the rest of the part is masked with a specially develop coating. The entire part is submerged in an etching solution prepared by Turco Products. The solution attacks exposed surfaces evenly at a constant rate until the desired amount of metal has been etched away.

Electronically-controlled, the chemical sculpturing process produces finished metal surfaces to accuracies of two-thousandths of an inch.

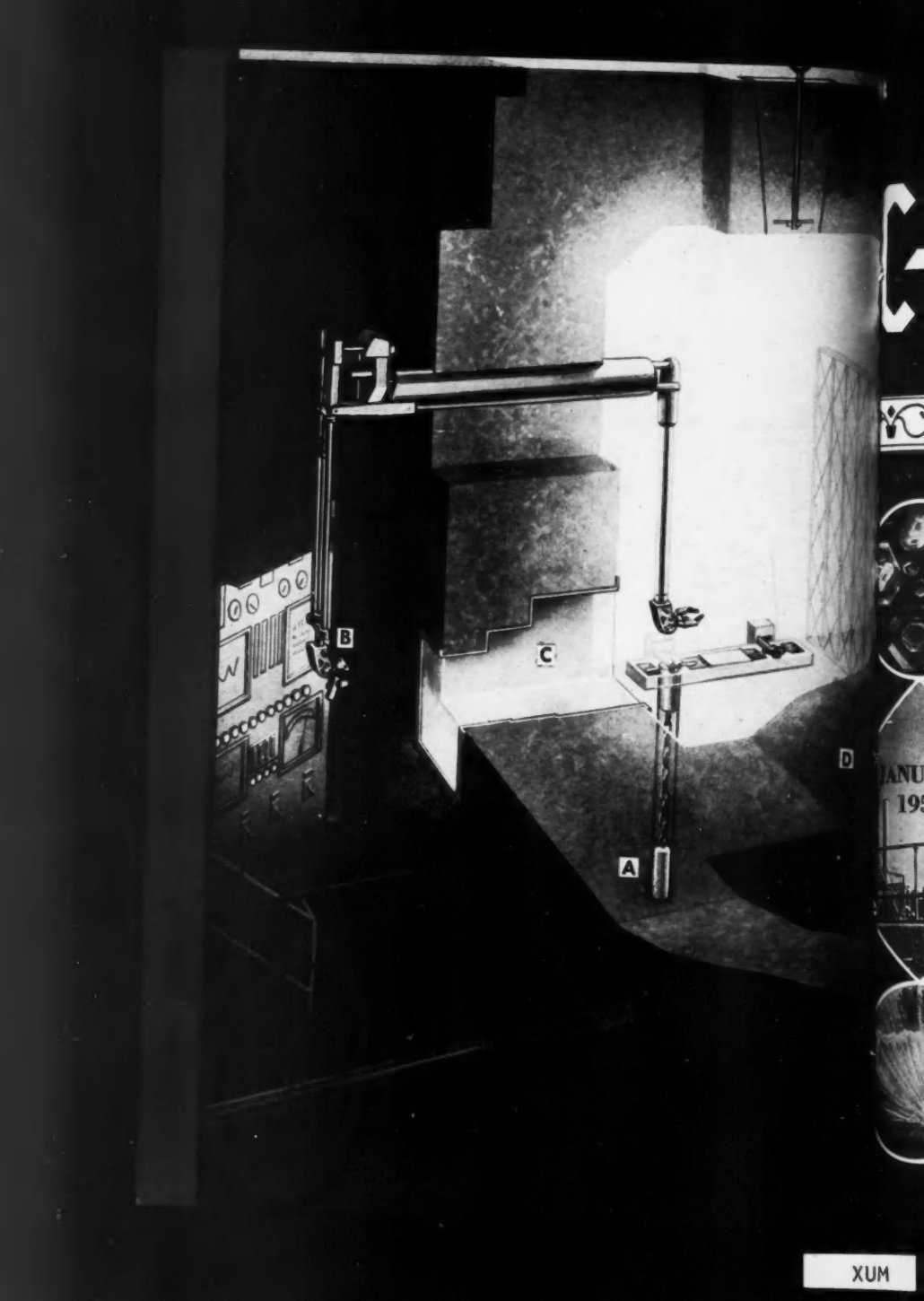
Most of the experimental work with chemical milling has been done with aluminum, but the process has been applied also to steel, stainless steel, titanium, and other metals.

➤ COLEMAN Instruments, Maywood, Ill., has issued a new 64-page catalog. In addition to a complete listing of Coleman instruments and accessories, the book contains brief descriptions of the most widely used analytical systems. Included are complete discussions of theory and practice of Absorption Spectrochemistry, Nephelometry, Colorimetry, pH measurement, Fluorimetry and Flame Photometry. Copies should be requested on company letterhead.

➤ RADIOACTIVE samples are practically part of the Geiger counter wall in the Model D47 Gas Flow Counter developed for C-14 and similar studies by Nuclear Corporation, 223 West Erie St., Chicago 10, Ill.

➤ WARM STAGES for microscopes, thermostatically controlled to keep slides at incubation temperatures, are offered in three models by Chicago Surgical and Electrical Co., 217 N. Desplaines St., Chicago 6, Ill. This company also makes incubators, paraffin embedding ovens, constant temperature serological water bottles and inspissators.

➤ TRANSDUCERS with metal jacketed and lined fully enclosed water cooled treatment chambers, flow-through chambers which can be bolted into a pipe line for continuous processing of materials, and expendable transducers for experimental purposes are obtainable from Rich-Roth Laboratories, 1240 Main St., Hartford, Conn.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